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CONTENTS

Editorial 53

Additive Compounds in Electroplating Baths 54
By Marvin Rubinstein

The Determination of Impurities in Nickel Plating Solutions—Part I 59
By Louis Silverman

A New Coating Thickness Measuring Instrument 64

United Chromium's Metal Finishing Laboratory 67

Electropolishing With Hexafluorophosphoric Acid 70
By Howard Martin and Dr. C. B. F. Young

Compression Distillation for Plating Water Supply 75
By Joseph B. Kushner

Shop Problems 79

Patents 81

Engineering Data Sheet—Nickel Plating 83

Recent Developments 84

Business Items 92

Motor City Plating News 100

Manufacturers' Literature 102

News from California 105

Associations and Societies 106

New Books 110

Letters to the Editor 112

Obituaries 113

COMING SOON

Next month's issue will be an International Issue, devoted entirely to reports from twenty foreign countries on the status of the electroplating and metal finishing industries there. History and growth of their plating industry, statistics on size, and the trends in application and use of various plating baths will be given.

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METAL FINISHING

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VENEZ - SEHEN - ESCUCHEN - DISCUTELO - LEARN*

A knowledge of several foreign languages is one of the essential tools of the worldly individual; a similar knowledge of the important things going on throughout the world in the field of electroplating is a necessity for the well-informed plating man.

American technical men generally are wont to look down on industrial products, activities and technical progress in foreign countries as being inferior or less advanced than that originating within our boundaries. Such a stand is perhaps engendered by our higher general living standards, industrial productivity, and quality and appearance of our manufactured articles, facts which were made quite evident during World War II.

Lest we become obsessed with the idea that this means that we are superior in technical know-how as well, it should be remembered that our prime asset lies not in any monopoly on brains, but in our vast resources of purchasing power, selling ability, and mass production facilities, all of which, when efficiently correlated, transform research and laboratory findings into commercial operations or articles. While we need not take a back seat either in the brains department, especially when it comes to the electroplating arts, it would be well to keep the above points in mind when listening to, talking to, or entertaining our foreign plating contemporaries who are fortunate enough to be able to attend the *Fourth International Conference* at Boston next month.

While they may be somewhat awed by the magnitude or speed of some of the things they will see while over here, we will undoubtedly not fail to be impressed with the completeness and accuracy of their observations and comments. Those of us who have occasion to keep abreast of foreign technical papers and developments are well aware of the meticulous scientific accuracy and soundness of approach which prevails throughout their work.

This meeting will provide the very best possible opportunity to discuss and compare electroplating and finishing practice and developments throughout the world. It is an opportunity which, for most, will not be presented again for perhaps another five years. It is difficult to see how anyone who attends, American or foreign, can fail to gain materially from this conference.

W. A. Raymond

Translated (Come - See - Listen - Discuss - Learn)

Additive Compounds in Electroplating Baths

By Marvin Rubinstein

Since leaving Cornell Univ. in 1943, Mr. Rubinstein has held positions as a plater, electrochemist, salesman, plating foreman, and plant manager in both manufacturing plants and job plating shops, and has also engaged in consulting work. He has also written several published technical articles on various aspects of metal finishing and plating.

AT a meeting of the Electrochemical Society a number of years ago, the story was told of a policeman who found a dead horse in Cholmondeley Street. Returning to his station, he started to file a report, but was stumped at the spelling of Cholmondeley. "Hey, Sarge," he shouted to his superior, "how do you spell Cholmondeley?" But the Sergeant didn't know either, so the policeman grabbed his hat and started out the door. "Where are you going?" asked the Sergeant. "I'm going to drag that horse over into King Street."

This story was told to illustrated what must be done to familiarize the "practical plater" with the importance and value of some of the more theoretical aspects of plating. Particularly is this true in the field of additive compounds, where little is known by the electrochemist and even less by the plater. A glance at the magazines read by the plater, with their paucity of articles on this important subject, only serves to prove the point. It is the hope of the author that this series of articles summing up the available information on the subject of additive compounds will drag this important topic from the Cholmondeley Street of the electrochemist to the King Street of the practicing plater.

What are the basic constituents of an electroplating bath? In its simplest form, every bath must contain at least three components; a salt of the metal to be plated, a current carrier, and a solvent. Using the acid copper bath as an example, you find copper sulfate to provide the copper ions and sulfuric acid to give hydrogen ions for increased conductivity. As in most cases, water is the solvent. (In this particular bath, the sulfuric acid has the subsidiary use of preventing the formation of basic copper compounds with resultant spongy deposits.)

Relatively few baths, however, have retained this simple make-up. In some cases, difficulties in operating the original bath created the need for extra constituents. Sometimes fortuitous accidents gave platers the clue to helpful additions. Lately, the demands of engineers for faster, brighter, finishes has increased the complexity of the plating bath. For all of these reasons, many and varied materials have been added to plating baths, increasing their working capacity or bettering the deposit. These additive compounds can be broken down into four groups commonly known in the field as wetting agents, addition salts, sequestering agents, and addition agents or brighteners.

Wetting Agents

Wetting agents are chemicals, usually organic in nature, which noticeably decrease the surface tension at the interface of the electrolyte and the electrodes. Worded more simply, a wetting agent enables the solution to come into closer contact with, or better "wet," the anodes and the work to be plated. Typical examples of commercially used wetting agents are Duponal ME in nickel plating solutions and DuPont RH 774 in cyanide copper and brass baths. Though there is no theoretical limitation on the amount of wetting agent to be added to the bath, most are added in relatively small quantities not exceeding 3%, and more usually in the neighborhood of 1%.

Addition Salts

Addition salts, on the other hand, usually appear in amounts ranging from 1-6 ounces per gallon. These may be defined as salts added to the plating bath to increase anode corrosion, provide buffer activity, or better the throwing power, conductivity, and anode and cathode efficiency. Addition salts generally either stabilize the bath or increase the efficiency of the operating conditions, as for example an increase in the limiting current density for sludge-free dissolution of the anodes. Some addition salts in common use are caustic soda in a cyanide zinc bath to increase efficiency

and anode corrosion, and boric acid in a nickel bath to act as a buffer. An addition salt may have other subsidiary purposes, as for example nickel chloride in the Watts bath. This not only acts as an addition salt in increasing anode corrosion, but also provides metallic ions for the plating process. Since it is the nickel sulfate (single nickel salts) which provides the bulk of the metallic ions, nickel chloride serves primarily as an addition salt.

Sequestering Agents

Sequestering agents are virtual infants in the metal finishing field, so much so that most readers have probably never heard of them. Their use in this country for the most part is limited to cleaning and anodizing solutions. They are included here, firstly because European platers have used them to a limited degree, and secondly, because the theory of their use seems sound enough to venture that they have a future in the plating field. A sequestering agent is best defined as a water-soluble ion exchanger. They serve to de-activate heavy metal and alkali earth ions by forming soluble, non-ionic compounds with them. Thus, heavy metallic impurities remain in solution, but are rendered harmless. They cannot precipitate out as sludge or scum or plate out as rough particles or dark spots. Polyphosphates and salts of ethylenediamine tetra-acetic acid are typical sequestering agents. Concentrations of from 0.1% to 5% are commonly used.

Though wetting agents, addition salts and sequestering agents will be dealt with briefly, this article will concern itself primarily with brighteners. Brightener addition agents may be defined as materials which are added to the plating bath, usually in small quantities, for the purpose of increasing the brightness and/or smoothness of the deposit, or controlling its mechanical properties. These mechanical properties include hardness, ductility, and tensile strength. Examples of addition agents are glue in acid copper baths to increase hardness and smoothness, and carbon disulfide in silver baths to increase brightness. As noted above, most addition agents appear in exceptionally small quantities, almost always less than 0.5 ounces per gallon.

History of Additive Compounds

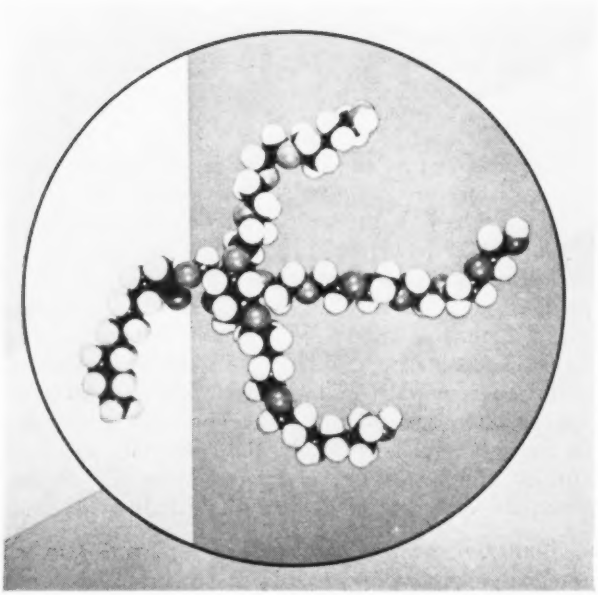
Knowledge of where and when addition agents were first used is very limited. A search of the patent literature takes one back to 1847. In that year, *Lyons and Milward* received a British patent for the use of bisulfide of carbon as a brightening agent for silver baths, though it had actually been used four years earlier. The fact that this compound is still being used by most platers gives one an idea of how slow progress has been in finding more useful addition agents. Bright copper was first observed in 1845, when wax molds were phosphorized in a solution of phosphorous in CS_2, then plated in acid copper. For the next link in the historical chain, one must shift to the field of electro-refining. As early as 1870, glue was used in acid copper solutions during the electrolytic refining operation to give denser, smoother deposits. A German, *Hübl* in 1886 observed that 0.1 per cent glycerine gave a dark brown, glossy copper plate from an acid bath. He also noted similar effects with benzole and turpentine. In 1899, a plater named *Foerster* obtained smooth, brittle acid copper deposits using traces of caoutchouc, and noted that such deposits contained carbon.

The reasons why carbon disulfide was tried by early silver platers or why glue was chosen to add to acid copper baths will probably never be known. In the early 1900's, however, we find new addition agents and also the manner of their discovery. A consultant, in 1902, while trying to check some difficulty in a nickel bath, had the solution stored in barrels while he checked the contacts. The glue sizing in the barrels dissolved somewhat in the nickel solution. Much to the consultant's surprise, the nickel bath now performed as never before. Fortunately, the consultant was both curious and intelligent, and figured out the answer. Thus, the early use of glue in nickel baths.

Similar discoveries were made about that time, when wooden tanks were replaced by steel. Nickel baths just didn't plate as well in the steel tanks. It wasn't long before smart platers began adding extracts of boiled wood chips to their solutions, with gratifying results. This was the beginning of the use of gums, resins, and eventually molasses as addition agents. The use of certain oils also got their start about this time. Platers, who took to the idea of floating oil on top of their solutions to prevent gas bubbles from rising and choking the operator, soon discovered that the oils often had peculiar effects on the plate as well.

As can be seen, most of these addition agents were discovered by fortuitous accidents. The use of casein in acid copper baths had a similar beginning. A plater accidentally dropped his lunch bottle of milk in the copper tank, with excellent results. And so many platers used milk in their copper baths for years, until a chemist discovered that it was the casein in the milk that was doing all the work. Today, casein is an often-used addition agent in acid copper baths. *Professor L. C. Mathers*, while testing glue as an addition agent for acid tin plating in 1918, had considerable difficulty with foaming. Realizing that certain phenolic or ring alcohols acted as foam controlling agents, he reached for a bottle of cresol handy on a nearby shelf, and poured a few cc's into the bath. The results of this lucky accident are that today glue plus cresol is a standard addition agent for acid tin baths. The cresol not only controls foaming, but also has brightening properties of its own. Had any other solution of the same type, e.g. phenol, been handy, the results would have been totally different.

Luck, however, for the most part comes only to those patiently plodding along with experiments. Professor Mathers is a perfect example; many of the most commonly used addition agents can be traced back to his original work and thinking. Starting his work at Cornell in 1907, he has put a lifetime of effort into the study of addition agents, employing both theoretical and empirical methods. In 1917, he discovered an addition agent for cadmium plating. The year 1918 brought out his discovery of glue plus cresol for acid tin plating. He first used rosin for alkaline lead plating in 1920. The ensuing years have seen extensive work



(Courtesy Atlas Powder Co.)

Figure 1. Additive compounds often have complicated molecular structures. Here is illustrated a wooden laboratory model of a "Tween," a typical non-ionic surface active agent. The black, white, and grey balls in the model represent different chemical elements, while the color division of the background symbolizes the affinity of part of the molecule for water and part for oil.

done in testing myriad waste and by-products of industrial manufacturing in an attempt to make them useful as addition agents for plating. Many of his original formulas are still in use today; many other brighteners have arisen as extensions of his ideas.

During the past fifteen years, most of the work on addition agents have been specifically aimed at bright nickel and bright copper solutions. The success of this experimentation is easily shown by the long list of excellent bright nickel and copper solutions now on the market. Most proprietary solutions are, after all, only standard baths with appropriate addition agents and wetting agents added.

The history of addition salts is likewise hidden in antiquity. Many started as integral parts of, or an impurity in the original bath. Some undoubtedly were discovered by accident. A few of the more recent ones such as sodium sulfate or sodium citrate in the "die cast" nickel solutions were first used with a definite electro-chemical idea in mind, that of depressing the metallic ion concentration at the cathode. All in all, however, the author has been unable to locate the origin of boric acid in nickel baths, Rochelle salts or sodium bisulfite in cyanide copper baths, caustic soda in alkaline tin, zinc, or cadmium baths. Only one thing is practically certain; early platers probably never added sodium carbonate to their alkali baths. That is one addition salt that probably arose of its own accord.

Wetting agents, being of more recent origin, have a well defined history. The early history of one type, soap, is not so recent. Soaps, the earliest known wetting agents, have been used for centuries. During the 1800's, sulfonated olive oil and fats started to replace soaps as wetting agents in the textile dying industries. That was the status until the first world war. Early in the war, Germany began to manufacture the first synthetic wetting agents, the alkylated naphthalene sulfonic acids and their salts. It was not until the early 1920's that these synthetics were first used in the American dyeing industries. Shortly after that, they found their way into metal cleaning and pickling solutions and from there to nickel plating baths. New uses during the past twenty-five years have developed the need for and the rise of more and better wetting agents. The fact that these have found use in many and varied fields as well as that of metal finishing has encouraged many large chemical manufacturing concerns to tackle this up-and-coming source of revenue. As a result, today's wetting agents are for the most part complicated organic compounds and mixtures sold under trade names such as Lyofix DE, Nekal B.X., Tritons, Spans and Tweens. Nickel solutions still are the principal users of wetting agents in the plating field, but bright plating of copper, brass, zinc, cadmium and tin today depend on wetting agents to improve the end product.

Like wetting agents, sequestering agents also got their start in the dyeing industries, but much more recently. Reference to their use before 1937 have not been found. In dyeing, these chemicals sequestered metallic impurities which tended to give variations in color from batch to batch. With these impurities out of action, more consistent results were obtained. Taking their cue from the cloth dyers, metal dyers in the anodizing field found sequestering agents equally effective in their dyeing baths. Working independently, manufacturers of commercial cleaners during recent years have used various polyphosphates as water softeners. These have successfully sequestered calcium and magnesium and prevented troublesome scum formation. Persistent research during the past four years has made available the organic sequestrants, e.g. ethylenediamine tetra-acetic acid, originally imported from Europe. This compound and its salts have found myriad uses both in and out of the metal finishing field. They were used successfully in Germany by *Brintzinger* in bright zinc, copper, cadmium, cobalt, brass and nickel plating baths.

The zinc plating bath is typical:

Sodium Carbonate (decahydrate)	8 oz./gal.
Ethylene bis-aminodiacetic acid	4 oz./gal.
Zinc Sulfate	4 oz./gal.
Sodium Hydroxide	to pH 10-11

In this particular case, the polyamino acid is being used both as a sequestering agent and an addition salt.

(Courtesy Atlas Powder Co.)

Figure 2. Illustration of manner in which wetting agents enable solution to "wet" the work more easily. Left side of photo shows droplets of water on surface of waxed glass plate. At right, wetting agent has been added. Note how globules spread out and make better contact with surface

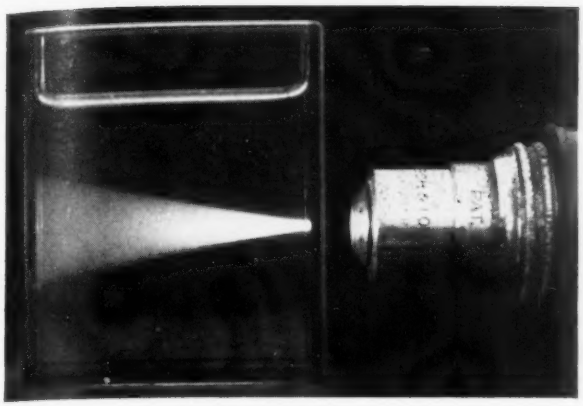


Figure 3. **Tyndall Cone Test usually reveals difference between a colloidal suspension and a true solution. Both are normally perfectly clear to the eye, but the colloidal suspension often reflects a beam of light, as shown above. True solutions do not.**

thus accounting for the unusually large concentration for this chemical.

Though these compounds offer the advantages of being non-toxic, stable, and not requiring distilled water, they have as yet not found wide use with platers. Their future, however, looks promising.

One final word on the history of additive compounds — it has hardly started yet. With more and more very pure, concentrated high-speed and bright plating baths hitting the market every day, the need for more effective, more stable, more economical addition compounds will become ever more evident.

Types of Addition Agents

Three types of addition agents are in use for improving electroplating deposits, namely:

(a) Metallic salts,
(b) Organic and inorganic crystalloids, and
(c) Colloids.

Metallic salts include such addition agents as cobalt or zinc salts in nickel baths, lead acetate in cyanide copper, or arsenic compounds in brass baths. In any alloy bath, each metallic salt may be considered an addition agent for the other. Thus, in a cadmium-zinc alloy bath, the cadmium may be considered a brightener for the zinc or vice versa.

Crystalloids used as brighteners are for the most part organic. These are salts, crystalline in form, which readily and completely dissolve in the solution. Tartaric acid, lactic acid, and sugar are typical organic crystalloids. Metaphosphoric acid is a commonly used inorganic crystalloid. The term crystalloid is often used to indicate a structure opposed to that of colloids.

Colloids comprise by far the largest group of addition agents in use. Colloids are not a type of compound. The term indicates a particle size division, rather than a chemical class. Theoretically, any material can be found or converted to the colloidal state. Colloids or colloidal matter are those substances which when added to a liquid have a particle size midway between that of materials in solution and those of suspension. To clarify this picture, consider the meaning of the terms "solution" and "suspension." When a soluble chemical such as sugar is added to water, the sugar divides up into its smallest particles (molecules). These molecules become completely dispersed among the water molecules, forming a homogeneous combination or solution. This solution is perfectly clear, will not scatter a beam of light passing through it, and will not settle out over a period of time. Through the finest microscope, no particles of the sugar can be seen.

If a chemical like finely divided carbon is added to water, an entirely different condition exists. The carbon is not soluble. On the other hand, its particles are so light that they do not quickly settle out at the bottom of the container. They are suspended in the water for quite some time before they slowly settle. During this time, there exists a suspension of carbon in water. The suspension is heterogeneous, murky or cloudy rather than clear, and will scatter or diffract light passing through it. Carbon particles are clearly distinguishable to both the microscope and the naked eye.

Obviously, the suspended carbon particles are much larger than the dissolved sugar particles. Now, if you consider a particle size somewhere between that of the suspended carbon and the dissolved sugar, you will have some idea of what colloids are. Colloids have a particle size ranging from that of the largest molecules to that of the finest suspensions. A colloidal suspension (or solution, as it is sometimes called) may be perfectly clear to both the naked eye or the microscope. Or, it may be slightly opalescent. Since it will often slightly diffract a beam of light, it can often be detected by an electron microscope, where a regular microscope fails. It may settle out occasionally, but when it does, the process takes a matter of months rather than hours or days. Colloids have particle sizes ranging from 10^{-5} to 10^{-7} centimeters in diameter. Most ordinary colloidal materials are organic, though even metals such as gold can be prepared in the colloidal condition. Casein and gelatine are colloids frequently used as addition agents.

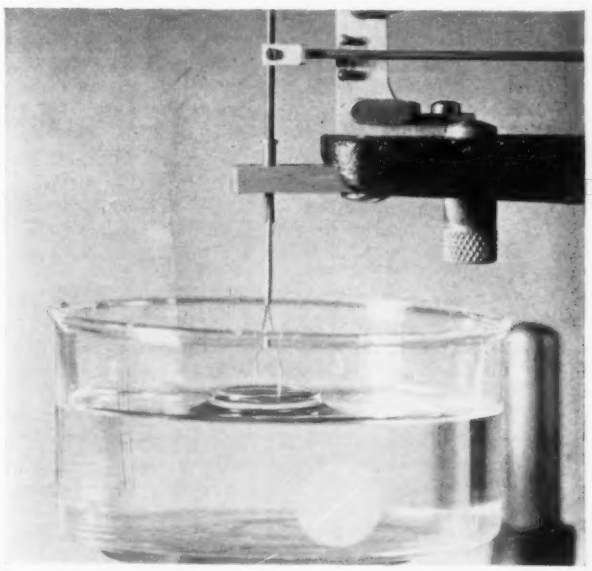


Figure 4. **Quantity of a given wetting agent in solution can be precisely determined by using a DuNuoy Tensiometer. Surface tension, in dynes per centimeter, is measured by finding the force needed to lift the platinum ring from the surface of the solution. For a given solution, a graph can be prepared relating surface tension to quantity of a specific wetting agent present; more wetting agent means less surface tension, less force needed to lift the ring.**

Types of Wetting Agents

Since this subject has been thoroughly covered in recent magazine articles and in the *Metal Finishing Guidebook*, it will be covered here only very briefly. Wetting agents are normally divided into three types. Anionic, Cationic, and Non-Ionic. The classification depends simply upon whether the wetting agent upon ionization travels towards the anode, cathode, or neither when a current is sent through the plating or cleaning bath. A more thorough discussion of the mechanics involved will be given later, when theory is covered. Oldest and most frequently used are the anionics. Included here are the soaps, and the alkyl aromatic sulphonates. Except for some use in reverse current cleaners, the cationics find no important use in metal finishing. Typical use for a cationic such as acetyl pyridinium sulfate is as a germicide and disinfectant. Non-ionics, as complex esters and ester-ethers, also find only a few uses in metal finishing, primarily as a constituent in soaking solvents and an occasional cleaner.

Neither addition salts nor sequestering agents have been classified according to types. One could list the addition salts according to use, or the sequestering agents according to chemical grouping, but no advantage would be gained for this discussion. It is important to note however, that there are both organic and inorganic sequestrants.

(*To be continued*)

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Bibliography

D. Price—*Wetting Agents in Electroplating;* Metal Finishing Guidebook, 1949, P. 412.

A. Mankowich—*Some Notes on Synthetic Detergents;* Metal Finishing, Vol. 47 (Nov., 1949), P. 48.

G. Leffingwell—*Synthetic Surface-Active Agents in Metal Finishing;* Met. Fin., Vol. 47 (April, 1949), P. 68.

H. W. Zussman—*Sequestering Agents: Their Use in Textile Processing;* American Dyestuff Reporter, June 27, 1949.

Atlas Powder Co.—*Surface Active Agents;* (Technical Bulletin), 1948.

H. W. Zussman—*Sequestering Agents; Soap and Sanitary Chemicals,* Feb., 1948.

F. C. Mathers and J. F. Suttle—*Electrodeposition of Lead from the Ethylbenzenesulfonate Bath;* Trans. A.E.S., Vol. 93 (1948), P. 47.

Alrose Chemical Co.—*Sequestrene;* (Technical Bulletin), 1948.

Brintzinger—P. B. Report #75627 (Dept. of Commerce).

O. M. Morgan—*A Surface Active Agent for the Cleaning of Metals;* Monthly Review of the American Electroplaters' Society, Vol. 34 (April, 1947), P. 430.

F. C. Mathers and M. M. Felger—*A New Agent for the Electrolytic Refining of Tin and Lead;* Transactions of the American Electrochemical Society, Vol. 90 (1946), P. 81.

H. H. Herbst—*Heat of Wetting of Metal Surfaces by Oils;* Petroleum Refiner, Vol. 25 (March, 1946), P. 121.

H. Silman—*Wetting Agents, Their Use in Electroplating and Allied Processes;* Metal Industry (London), Vol. 65 (Nov. 1944), P. 298 and (Nov. 24, 1944), P. 330.

F. E. Bartell—*Wetting Agents;* Industrial and Engineering Chemistry, Vol. 33 (June, 1941), P. 737.

R. F. Davis, K. M. Wolfe, and W. G. France—*Effect of Wetting Agents on Electrodeposition of Nickel;* Industrial and Engineering Chemistry, Vol. 33 (Dec., 1941), P. 1546.

S. Lenher—*The Expanding Applications of Wetting Agents;* Chemical Industries, Vol. 48 (March, 1941), P. 324.

D. S. Hartshorn, Jr.—*Surface Tension Phenomena and Surface Active Materials;* Met. Fin., Vol. 39 (March, 1941), P. 123.

F. C. Mathers—*Some Adventures in Electrochemistry;* Trans. A.E.S., Vol. 79 (1941), P. 38.

W. Blum, A. O. Beckman, and W. R. Meyer—*General Principals and Methods of Electroplating;* Trans. A.E.S., Vol. 80 (1941), P. 249.

C. L. Faust—*Alloy Plating;* Trans. A.E.S., Vol. 80 (1941), P. 301.

E. Raub and M. Wittum—*The Inflence of Organic Compounds in Nickel Plating Solutions;* Met. Fin., Vol. 38 (April, 1940), P. 206; (June), P. 315; and (August), P. 429.

D. S. Hartshorn, Jr.—*Surface Tension of Plating Solutions;* Met. Fin., Vol. 38 (Sept., 1940), P. 476.

F. C. Mathers and W. J. Guest—*Effect of Glycerine on the Throwing Power of Plating Baths;* Trans. A.E.S., Vol. 78 (1940), P. 339.

F. C. Mathers—*Complex Cations as the Important Influence in Plating Baths;* Proceedings of the American Electroplaters' Society, Vol. 27 (1939), P. 134.

C. B. F. Young—*The Effect of Certain Wetting Agents Upon Nickel Deposits;* Proceedings A.E.S., Vol. 27 (1939), P. 187.

Newark Branch A.E.S.—*Wetting Agents in Nickel Plating Solutions;* Proceedings A.E.S., Vol. 26 (1938), P. 225.

W. R. Meyer and A. Phillips—*The Structure of Electrodeposited Copper Alloys;* Trans. A.E.S., Vol. 73 (1938), P. 377. Patents #2,130,505 and #2,240,957.

C. G. Fink and M. Kolodney—*Electrodeposition of Manganese Using Insoluble Anodes;* Trans. A.E.S., Vol. 71 (1937), P. 287.

G. Egeberg and N. E. Promisel—*Studies in Evaluating The Brightness of Electrodeposits;* Electrodepositors' Technical Society Journal, Vol. 13 (1937), Sections 29 and 30.

L. B. Hunt—*The Mechanism of Electrodeposition;* Trans. A.E.S., Vol. 65 (1934), P. 413.

R. Taft—*Theories of Addition Agent Action;* Trans. A.E.S., Vol. 63 (1933), P. 75.

R. A. Claussen and H. L. Olin—*Some New Organic Addition Agents for Cadmium Electroplating;* Trans. A.E.S., Vol. 63 (1933), P. 87.

L. B. Hunt—*A Study of the Structure of Electrodeposited Metals, Part I;* Journal of Physical Chemistry, Vol. 36 (March, 1932), P. 1006.

W. Blum—*Addition Agents in Electrodeposition;* Colloid Chemistry (Edited by J. Alexander), Vol. 4 (1932), Chapter 33, P. 527.

M. Shikata and N. Hosaki—*The Behavior of Colloidal Particles at an Electrode;* Chemical News, Vol. 140 (Jan. 24, 1930), P. 55.

B. Clark and E. O. Jones—*The Effect of Addition Agents Upon the Conductivity, Cathodic Polarization, and Grain Size of Deposits Obtained from the Cell: Cu/CuSO$_4$, H$_2$SO$_4$/Cu;* Transactions of the Faraday Society, Vol. 25 (1929), P. 583.

E. F. Kern and R. W. Rowen—*Electrode Potentials of Copper Anodes and Copper Cathodes;* Trans. A.E.S., Vol. 56 (1929), P. 379.

W. Blum—*Colloids in the Electrodeposition of Metals;* Colloid Symposium Annual, Vol. 5 (1927), P. 301.

G. Fuseya and M. Nagano—*Addition Agents in Electrodeposition;* Trans. A.E.S., Vol. 52 (1927), P. 249.

P. K. Frolich, G. L. Clark, and R. H. Aborn—*Electrochemical and X-Ray Studies of Lead Deposits;* Trans. A.E.S., Vol. 49 (1926), P. 369.

G. Fuseya and K. Murata—*The Common Properties of Addition Agents in Electrodeposition;* Trans. A.E.S., Vol. 50 (1926), P. 235.

E. F. Kern and A. A. Capillon—*Addition Agents in Tin Refining Electrolytes;* Trans. A.E.S., Vol. 45 (1924), P. 109.

(*Concluded on page* 78)

The Determination of Impurities in Nickel Plating Solutions—Part I

By Louis Silverman, *Los Angeles, Calif.*

WITH the increasing use of bright nickel baths, with their attendant problems of bath contamination and purification, it is essential to have accurate methods for determining the concentration of such impurities, which are usually present in small quantities. The following methods are some which have been thoroughly tested for accuracy, and are presently in use by the author for regular analyses of nickel baths.

Analytical methods for impurities involve procedures which are a little more complicated than the average plating chemist is called upon to handle, but with a little practice all these methods can be mastered and accurate results obtained.

Aluminum

PRECISION COLORIMETRIC METHOD FOR SMALL AMOUNTS

Range — .02 to .0001 oz./gal.
Interfering Elements — Beryllium

Special Apparatus Required: Hold a thistle tube horizontally above a Fisher burner and heat at a spot about midway along the length of the tube. When the glass becomes soft, pull horizontally with both hands and draw out the tube to pencil-point thickness. Cool the tube, then cut the tube with the file at a pencil-point thickness spot. This tube will deliver a fine stream of liquid.

1. Pipette 25 ml. of sample into a 150 ml. beaker and add 25 ml. of water.
2. Drop in a 10% sodium hydroxide solution, while stirring, until a slight precipitate forms.
3. Add just enough 10% hydrochloric acid solution to redissolve the precipitate. Warm the solution to 60-80° C.
4. To a 400-ml. beaker add 75 ml. of water and 7.5 grams of sodium hydroxide. Stir, to dissolve the caustic.
5. Place the drawn-out thistle tube in a funnel stand, above the 400-ml. beaker. Slowly pour the warm nickel solution through the thistle tube into the caustic solution, constantly stirring the caustic solution.
6. Wash the small beaker with water, draining into the thistle tube and beaker.
7. Add 0.1 gram of sodium carbonate to the 400 ml. beaker.
8. Place the beaker on the hot plate, and heat just to the boiling point. Stir to prevent bumping. Set the beaker on the table top and allow the precipitate to settle.
9. First decant the supernatant liquid through a 15 cm. No. 40 Whatman paper, containing paper pulp, into another 400 ml. beaker, then wash the precipitate into the paper with a hot 1% sodium carbonate solution.
10. Wash the precipitate 3 times with the carbonate solution. Discard the paper and contents.
11. Add 3 drops of methyl orange solution (1 gram per liter of water) to the filtrate. Add hydrochloric acid until the solution turns red, and add 5 ml. in excess.
12. Boil the solution for 5 minutes to get rid of carbon dioxide. Cool the solution and add 50 grams of ammonium chloride.
13. Add 1 mg. of barium chloride.
14. Add ammonium hydroxide until the red indicator turns yellow, and add 5 drops of ammonium hydroxide in excess.
15. Heat the solution just to boiling, then set the beaker on the table top. Stir in a little paper pulp, and let stand for 2 or more hours.
16. Filter the solution through an 11 cm. No. 40 Whatman paper and wash with a 5% ammonium chloride solution which has been neutralized to methyl orange with ammonium hydroxide. Discard the filtrate.
17. Return the paper and contents to the original beaker. Add 15 ml. of nitric acid and 6 ml. of perchloric acid. Mix.
18. Cover the beaker and evaporate to heavy fumes of perchloric acid. Cool.
19. Add not more than 25 ml. of water, cover the beaker, and boil for 3 minutes. Cool.
20. Filter the solution through a 9 cm. paper into a 50 ml. volumetric flask, and wash the beaker and paper with 10 ml. of water, draining into the flask.
21. Carefully add 2 to 5 ml. ammonium hydroxide to the flask until the solution turns litmus paper blue, then just acidify with 10% hydrochloric acid solution. Cool the solution in the volumetric flask to room temperature.
22. Dilute the solution to the mark with water and mix well. This flask contains the aliquoting solution "A", for final colorimetric analysis.
23. Clean three 100-ml. volumetric flasks with chromic acid cleaning solution, then wash well with water. Number the flasks A-5, A-10 and A-25.
24. By pipette, withdraw aliquots of 5 ml., 10 ml. and 25 ml. from the 50 ml. volumetric flask, "A", and transfer them to the A-5, A-10, and A-25 100 ml. volumetric flasks, respectively.
25. Add 5 mg. of hydroxylamine hydrochloride to each 100-ml. flask.
26. Add 15 ml. of the aluminon composite solution (see below).
27. Add sufficient water to each flask to fill to the neck, stopper the flasks, and place the flasks in a container of boiling water, and heat for 10 minutes. Set the flasks on the table top, to cool to room temperature (10-20 minutes).
28. Dilute the solutions to the marks, and mix well.

29. Compare with standards, prepared according to steps 30-32. One of the three should match or give the desired information. Read "mg. Al" from the curve, or comparison tubes.

Standard Solutions and Reagents

ALUMINUM STOCK SOLUTION

Accurately weigh 0.100 gram of pure aluminum. Transfer the metal to a 250 ml. beaker and dissolve in 25 ml. of water, 10 ml. of hydrochloric acid and one drop of hydrogen peroxide. Pour the solution into a 1 liter volumetric flask, dilute to the mark with water and mix. 1 ml. = 0.1 mg. of aluminum.

ALUMINUM STANDARD SOLUTION

Pipette 100 ml. of Aluminum Stock Solution into a 1 liter volumetric flask, add 10 ml. of hydrochloric acid and dilute to the mark with water. Mix well. 1 ml. = 0.01 mg. of aluminum.

BENZOIC ACID SOLUTION

Dissolve 10 grams of benzoic acid in 100 ml. of methyl alcohol.

ALUMINON SOLUTION

Transfer 0.500 grams of aluminon to a 500 ml. volumetric flask and half fill the flask with water. Mix. Pour in 50 ml. of the benzoic acid solution (above) dilute to the mark with water and mix. Age 3 days.

BUFFER SOLUTION

Place 215 ml. of glacial acetic acid in a 600 ml. beaker and set the beaker in a cold water bath. Slowly add 235 ml. of ammonium hydroxide. Pour the solution into a 500 ml. cylindrical graduate and dilute to the mark with water. If 5 ml. of this solution is diluted to 100 ml. with water, the pH of the solution should be about 5.25.

GELATIN SOLUTION

Transfer 5 grams of ordinary gelatin to a 600 ml. beaker, add about 250 ml. of hot water, cover and keep hot until the gelatin dissolves. Cool. Add 50 ml. of Benzoic Acid Solution (above) and mix. Pour the solution into a 500 ml. cylindrical graduate and dilute to the mark with water. Age 3 days.

ALUMINON COMPOSITE SOLUTION

Clean a 2.5 liter "acid bottle" with chromic acid cleaning solution and rinse well with distilled water.

Pour in the 500 ml. of aluminon solution, the 500 ml. of buffer solution and the 500 ml. of gelatin solution. Mix well. Let stand one or more days before using. This solution is usable for 6 months.

Preparation of Standard and Graph

30. Prepare five 100 ml. volumetric flasks.
31. Add 0, 1, 2, 3 and 4 ml. (0, 0.01, 0.02, 0.03 and 0.04 mg. Al), respectively, of Aluminum standard solution to flasks. Proceed according to No. 25-28.
32. If a colorimeter is available, determine the transmittancies vs. concentrations. The curve should be straight from 0.01 to 0.04 mg. of aluminum. Read "mg. Al" from the curve, for the test sample.
    For visual comparisons, pour the solutions into Nessler tubes, or test tubes, and compare with the unknown samples. Estimate "mg Al" content for the test sample.

Calculations

$$\text{Al. oz. per gal.} = \frac{0.1335 \times 1000 \times 50 \times (\text{mg. Al})}{(\text{ml. of sample}) \times (\text{A-ml.}) \times 1000}$$

$$= \frac{6.68 \times (\text{mg. Al})}{(\text{ml. of sample}) \times (\text{A-ml.})}$$

References

Craft, C. H. and *Makepeace, G. R.*, Ind. Eng. Chem., Anal. Ed., 17,206 (1945).

Silverman, L., Chemist-Analyst, 37, 3, p. 62(1948).

Ammonium

RAPID QUALITATIVE TEST.

Range — 0.1 oz. per gal., or more.

1. Place 20 ml. of a 10% sodium hydroxide solution in a 300-ml. tall-form beaker.
2. Pipette 5 ml. of sample into the beaker, allowing the solution to drip down the wall of the beaker.
3. Smell the beaker to detect the odor of ammonia.
4. If there was no odor, cover the beaker with a watch glass which has a moist piece of red litmus paper on the underside.
5. Warm on the steambath, but do not boil. The red litmus paper turns blue if ammonium salts are present.

PRECISION DISTILLATION-VOLUMETRIC METHOD.

Range — 0.005 to 4 oz. per gal.

Interfering Elements:

Cyanides, nitrates and nitrites are presumed to be absent. Certain organic reagents may give results about 0.05 oz. per gal. too high. Nickel, cobalt, iron, zinc, copper, etc., do not interfere.

Size of sample:

If NH_4 may be 0 to 0.2 oz. per gal. use a 25-ml. sample.

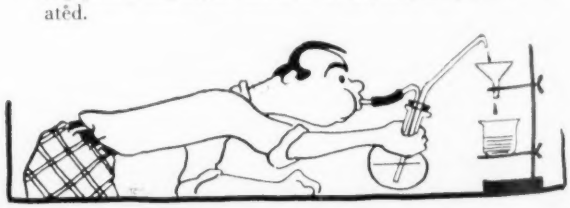
If NH_4 may be 0.2 to 0.5 oz. per gal. use a 10-ml. sample.

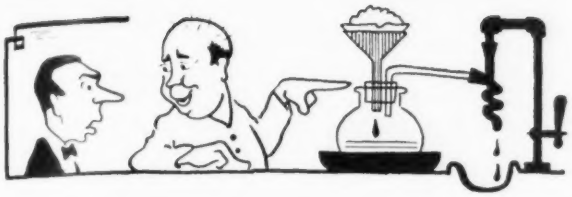
If NH_4 may be 0.5 to 1.0 oz. per gal. use a 5-ml. sample.

If NH_4 may be 1.0 to 2.0 oz. per gal. use a 5-ml. sample.

If NH_4 may be 2.0 to 4.0 oz. per gal. use a 2-ml. sample.

1. Charge the Erlenmeyer (receiver) flask as follows:
   If the NH_4 may be 1 oz. per gal., or less, *pipette* 25 ml. of standard 0.1-N hydrochloric acid solution into the receiver;
   If the NH_4 may be 1 to 4 oz. per gal., *pipette* 50 ml. of standard 0.1-N hydrochloric acid solution into the receiver.
2. Add 3 drops of a 0.1 per cent methyl red to the receiver.
3. Pipette the test sample into the Kjeldahl flask, add 5 drops of phenolphthalein solution, 1 gram of 20-mesh zinc, and 100 ml. of water. Mix.
4. Stopper the Kjeldahl flask with a two-holed stopper holding the dropping funnel and the splash tube which is connected to the upper end of the water condenser. Attach the bubbler tube to the lower end of the condenser and insert the bubbler into the receiver. Add enough water to the receiver to make the volume about 100 ml. Arrange the height of the receiver so that the bubbler is in the solution, but does not touch the bottom of the receiver.
5. Dissolve 15 grams of sodium hydroxide in 50 ml. of water, and cool somewhat. Pour this sodium hydroxide solution into the dropping funnel and slowly drain nearly all of this solution into the Kjeldahl flask. (The solution temporarily turns red.) Leave at least 1 ml. in the funnel. Shake the Kjeldahl flask, and dry the bottom of the flask with a cloth.
6. Slowly heat the solution in the Kjeldahl flask to the boiling point, and distill until 75 to 100 ml. have been evaporated.





7. Continue heating, lower the receiver until the bubbler is out of the liquid, *then* slowly open the stopcock of the dropping funnel to admit air, and *then* remove the burner.
8. Wash down the bubbler with water and drain into the receiver. The solution in the receiver must still be red (acid); if yellow, more ammonium was present than anticipated. (In this case repeat the test with a smaller sample.)
9. Titrate the red solution in the receiver with a standard 0.1-N sodium hydroxide solution, until the indicator turns to orange or orange-yellow. Record this reading as "ml. Back Titration."
10. Run a "Blank-Run" using all materials and solutions as used in the test run. Titrate the red solution in the receiver, as above. Record this reading as "ml. Blank Titration."
18. Note that only the two standard sodium hydroxide solution readings are required.

Calculations

$$NH_3 \text{ oz. per gal.} = (\text{ml. Blank—ml. Back Titration}) \times \text{Normality of NaOH} \times \frac{2.41}{\text{ml. of sample}}$$

$$NH_4Cl \text{ oz. per gal.} = (\text{ml. Blank Titration—ml. Back Titration}) \times \text{Normality of NaOH} \times \frac{7.15}{\text{ml. of sample}}$$

$$(NH_4)_2SO_4 \text{ oz. per gal.} = (\text{ml. Blank-ml. Back Titration}) \times \text{Normality of NaOH} \times \frac{8.83}{\text{ml. of sample}}$$

Cadmium

QUALITATIVE TEST.

Range — about 0.0005 oz./gal. minimum.
Interfering elements — none.

1. Pipette a 25-ml. sample into a 400-ml. beaker and dilute to 150 ml. with water.
2. Add about 1 mg. of copper sulfate, 5 drops of methyl orange solution (1 gram per liter of water), and 5 grams of citric acid.
3. If the solution is not red, add hydrochloric acid until the solution turns red, then add ammonium hydroxide until the solution turns to yellow.
4. Add formic acid until the solution again turns red, and then add 2 ml. in excess.
5. Add 5 grams of ammonium sulfate, heat the solution to 60-80°C., and pass in a stream of hydrogen sulfide for 5 minutes.
6. Let the solution stand for 15 minutes, mix in a little paper pulp, and filter the solution through a 9 cm. paper.
7. Wash well with a 1% formic acid solution, saturated with hydrogen sulfide, to remove nickel. Remove the paper and contents from the funnel and place them in a 250-ml. beaker.
8. Add 15 ml. of nitric acid and 5 ml. of perchloric acid. Mix.
9. Heat to destroy the paper and evaporate to fumes of perchloric acid. Cool, add 10 ml. of water and one drop of hydrochloric acid, then heat to boiling. If a precipitate forms, filter it off on a 9 cm. paper, wash and discard the paper.
10. To the filtrate, add, dropwise, ammonium hydroxide until the solution is alkaline to litmus paper.
11. Add 0.1 gram of potassium iodide. If a precipitate forms, filter it off on a 9 cm. paper, wash and discard the paper.
12. Evaporate the filtrate to about 10 ml.
13. Lay three strips of a filter paper (*Whatman No. 120 or S. and S. No. 60*) across a small beaker. Add a drop of the test solution to the first strip, a drop of water to the second strip and a drop of cadmium chloride solution (1 mg. of cadmium chloride per 100 ml. of water) to the third strip.
14. Before the drops are completely absorbed add single drops of dipyridyl reagent (see below) to each. When cadmium is present, red flecks, or a ring, more intense than the reagent color will appear. The "blank" and "known" solutions aid in the comparison.

Reagents

Transfer 0.25 gram of a, a'–dipyridyl and 0.146 gram of ferrous sulfate ($FeSO_4 \cdot 7H_2O$) to a 100-ml. beaker. Add 50 ml. of water and mix to dissolve the solids. Add 10 grams of potassium iodide, and stir for a period of 30 minutes. Filter the solution through a 9 cm. paper into a small reagent bottle, and stopper the bottle. The reagent is stable, but if a cloud develops, the reagent is again clarified by filtration.

Reference

Feigl, F., and *Miranda, L. I.*, Ind. Chem., Anal. Ed., 16,141 (1944).

PRECISION COLORIMETRIC METHOD.

Range — about 0.0005 oz./gal. minimum.
Interfering elements — none.

1. Proceed as in the qualitative test for cadmium (above) No. 1 to 7 inc., to obtain cadmium sulfide on the filter paper. (In Black Nickel Plating Solutions, zinc is present and appears as a white precipitate. In this case, follow the instructions below. For other solutions (zinc absent), start at No. 2 below. Special steps to remove zinc and tin: Remove the filter paper and contents and place them in a porcelain crucible. Heat to char the paper, then ignite the crucible at 600-800°C. to completely burn the carbon. Cool the crucible. Place 1 gram of ammonium iodide in a mortar, tap the contents of the crucible into the mortar, and then grind the solids together. Return the mixture to the same crucible, and reheat over the wire gauze to volatilize zinc and tin. Cool. Brush the residue into a 250-ml. beaker. Proceed to step No. 3 below.)
2. Remove the paper and contents from the funnel and place them in a 250-ml. beaker.
3. Add 15 ml. of nitric acid and 5 ml. of perchloric acid. Heat (to destroy the paper) and evaporate to heavy fumes of perchloric acid. Cool, add 25 ml. of water and boil for 5 minutes. Cool.
4. Add 1 gram of sodium or potassium tartrate, and stir to dissolve the salt.
5. Drop in a piece of litmus paper and add 20% sodium hydroxide solution until the litmus paper turns blue. Add 25 ml. of sodium hydroxide solution, in excess.
6. Dilute the solution to about 100 ml. and pour the solution into a separatory funnel, A. Prepare, also, a second separatory funnel, B, to which is added 20 ml. of dithizone-chloroform solution. (See below)
7. To funnel A, add 5 ml. of dithizone solution, close the funnel and shake the funnel under the cold tap water for 30 seconds. Return the separatory funnel, A, to its rack, and allow the layers to separate for 2 minutes.
8. If the lower, chloroform layer is no longer green, carefully drain this layer into funnel B.
9. Again extract the water solution in funnel A with 5 ml. of green dithizone solution and again drain the dithizone layer into funnel B. Repeat the 5-ml. extractions (sometimes 3 to 5 times) until the green dithizone solution is not affected by the water solution. The extraction is now completed. Note the amount of reagent used (see No. 15, below). Discard the contents of funnel A.
10. To funnel B, add 25 ml. of water and shake for 30 seconds. Allow layers to separate and drain the lower, red layer into separatory funnel C. Discard the water layer in funnel B.
11. Mix 5 ml. of hydrochloric acid and 40 ml. of water in a small beaker, and cool.

12. Add the hydrochloric acid solution to the dithizone solution in funnel C. Shake the funnel for 30 seconds and allow the layers to separate. (The water layer must be acid to Congo Red paper). Drain out and discard the lower, chloroform, layer. Retain the upper, acid layer.
13. Add 1 gram of sodium or potassium tartrate dissolved in 10 ml. of water.
14. Drop in a small piece of red litmus paper, then add a 20% sodium hydroxide solution until the litmus paper turns blue. Add 10 ml. of sodium hydroxide in excess. Cool.
15. Refer to No. 9 above, and extract the alkaline solution with 10 ml. portions of dithizone until the green color no longer changes to red. Operate as rapidly as possible.
16. Drain the red extracts into a 25-ml., a 50-ml. or a 100-ml. volumetric flask (depending on the intensity of color—see below). Dilute to the mark with chloroform. Mix. Cool.
17. Photometer. Quickly obtain the "% Transmittancy" at 520 mμ, and red "mg. Cd" from the curve.

Visual comparison. Quickly compare the intensity of color of the test solution with those standards. Find "mg. Cd" by comparison.

(Note—Steps No. 15 to 17 must be performed as quickly as possible to prevent "fading" of the color. Should a poor color be obtained, return the chloroform extract to the separatory funnel, and start again at Step. 11.)

Preparation of Standards

CADMIUM STOCK SOLUTION

Accurately weigh 0.100 gram of pure cadmium metal. Transfer the metal to a 250 ml. beaker and dissolve in 25 ml. of water, 10 ml. of hydrochloric acid and one drop of hydrogen peroxide. Warm until bubbling ceases. Pour the solution into a 1 liter volumetric flask, add 25 ml. of hydrochloric acid, and dilute to the mark with water. Mix well. 1 ml. = 0.10 mg. of Cd.

CADMIUM STANDARD SOLUTION

Pipette 100 ml. of Cadmium stock solution into a 1 liter volumetric flask, add 10 ml. of hydrochloric acid and dilute to the mark with water. Mix well. 1 ml. = 0.010 mg. of Cd.

DITHIZONE SOLUTION

Dissolve 0.010 grams of dithizone in 500 ml. of C. P. chloroform. Keep in a cool, dark place. When a red tint appears in the bottom of the glass container, discard the reagent. The reagent will keep for 5 days in an electric refrigerator.

PREPARATION OF COLOR STANDARDS

Set up a series of separatory funnels, and add 0 ml. (0.00 mg. Cd), 1.0 ml. (0.01 mg. Cd), 3.0 ml. (0.03 mg. Cd), etc. of Cadmium standard solution to the funnels marked 0, 1, 3, etc. Add 5 ml. of hydrochloric acid and 40 ml. of water to each funnel. Mix. Start at No. 13, above, and proceed through to Step 17 using the 50-ml. volumetric flasks. For the photometer, plot a curve using a filter as close to 520 mμ, as possible.

PURITY OF REAGENTS AND BLANKS

The "0.0 mg/l." test run represents a blank on reagents, and all subsequent tests should be run with about the same amounts of reagents. All reagent bottles should be labeled and reserved for this test. New curves must be drawn when the reagents have been consumed.

If the test run used a 25 ml., a 50 ml. or a 100 ml. volumetric flask (Step 16), the standards are run in similar size flasks.

Calculations

$$\text{Cd. oz. per gal.} = \frac{133.5}{25} \times (\text{mg. Cd}).$$

Reference

Cholak, J., and *Hubbard, D. M.*, Anal. Ed., 16.333 (1944).

Chromium

PRECISION COLORIMETRIC METHOD.

Range — .0004 oz./gal.

Interfering elements — Vanadium, Molybdenum.

Special apparatus: Use the drawn-out thistle tube, prepared under Aluminum.

1. Pipette a 5 ml. sample into a 250 ml. beaker and add 50 ml. of nitric acid. Cover with a watch glass, and slowly (15-20 minutes) evaporate the solution to a volume of about 5 ml.
2. Add 50 ml. of water, and warm until the odor of chlorine is not easily detected.
3. Add a 10% sodium hydroxide solution until a permanent precipitate forms, then drop in nitric acid until the precipitate redissolves.
4. To a 400 ml. beaker add 100 ml. of water, 5 grams of sodium hydroxide, and 2 grams of sodium peroxide.
5. Place the drawn-out thistle tube in a ring stand above the 400 ml. beaker. Slowly pour the nickel solution through the funnel into the 400 ml. beaker, shaking the 400 ml. beaker, continually. Wash out the small beaker and funnel with water.
6. Heat the 400 ml. beaker until the solution begins to simmer, and maintain at this temperature until no more bubbles form.
7. Swirl the hot liquid to test for the presence of oxygen bubbles. Re-heat if necessary. Peroxide must be decomposed at this point. Cool the solution.
8. Transfer the solution and precipitate to a 250 ml. volumetric flask. Dilute to the mark with water, and mix well. The precipitate settles quickly.

Preliminary Estimation

9. Decant about 10 ml. of solution into a small beaker.
10. Acidify (to litmus) with 10% sulfuric acid. Add 0.5 ml. in excess.
11. Add 1 ml. of diphenylcarbazide reagent (See below). From the intensity of the violet color, estimate the correct volume of aliquot, A, to be withdrawn from the 250 ml. volumetric flask for either photometric or visual comparison.

Preparation of Standards and Solutions

CHROMIC ACID STOCK SOLUTION

Powder and dry at 100°C., about 1 gram of potassium dichromate. Accurately weigh 0.0282 gram of dichromate and transfer it to a 1 liter volumetric flask. Dissolve the solid with water, dilute to the mark, and mix. 1 ml. = 0.01 mg. Cr.

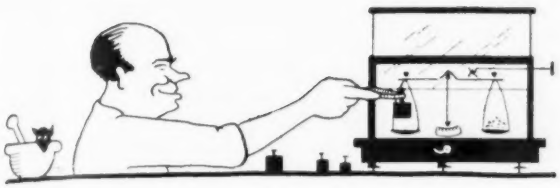
CHROMIC ACID STANDARD SOLUTION

By pipette, withdraw 100 ml. of chromic acid stock solution and transfer it to a second 1 liter volumetric flask. Dilute to the mark with water, and mix well. 1 ml. = 0.001 mg. Cr.

DIPHENYLCARBAZIDE SOLUTION

Dissolve 0.25 gram of diphenylcarbazide in 100 ml. of alcohol. Prepare fresh daily.

12. Prepare a series of 50 ml. volumetric flasks. Add to each 1 ml. (0.001 mg. Cr), 2 ml. (0.002 mg. Cr), 3 ml. (0.003 mg. Cr), etc., of Chromic acid standard solution, and letter the flasks 0, 1, 2, 3, etc.
13. Half-fill each flask with water, and add 1 ml. of diphenylcarbazide solution to each flask.
14. Drop a piece of litmus paper into each flask, and add 10% sulfuric acid to each flask, until the litmus paper turns red. Add just 4 ml. of 10% sulfuric acid in excess. Dilute the solutions in each flask to the mark with water, and mix well.
15. Photometric procedure. Use a 520 mμ filter, or nearest to this, available. Obtain "% Transmittancies" for the various Chromic Acid standard solutions. Plot "% Transmittancies" as ordinates and "mg. Cr" as abscissa.



Visual comparison. Make note of the color intensities of the various Chromic acid standard solutions, as compared to the various unknown samples.

Final Determination of Chromium Content

A preliminary estimate of the chromium content was made in No. 11, above. Transfer, by pipette, the correct aliquot, A, from the 250 ml. volumetric flask, to the 50 ml. volumetric flask. If the aliquot, A, should be 40 ml. or more, transfer the aliquot to a beaker, evaporate to about 25 ml. and then wash into the 50 ml. volumetric flask. Record the original volume of aliquot, A.

16. Continue as directed from Steps 12-15 and determine "mg. Cr" by use of the photometer and curves or by direct comparison with known standards.

Calculation

$$\text{Cr, oz. per gal.} = 6.68 \times \frac{\text{mg. Cr}}{\text{A, ml.}}$$

Cobalt

PRECISION COLORIMETRIC METHOD.

Range — minimum detected, 0.0025 oz. per gal.
Interfering elements — none.

1. Pipette a 10 ml. sample into a 100 ml. beaker.
2. Add 15 ml. of nitric acid and 10 ml. of perchloric acid. Cover, and heat the beaker until heavy fumes of perchloric acid appear. Continue heating until the volume of liquid becomes low, and salts will appear when the beaker is cooled in air for 60 seconds.
3. Add 40 ml. of water and 1 ml. of hydrochloric acid. Boil for one minute, then cool.
4. Add 15 grams of ammonium thiocyanate, and stir to complete solution. Test the solution with Congo Red paper, which should turn blue, pH 4; if not add hydrochloric acid until the paper does turn blue.
5. Add 5 ml. of a 10% ammonium citrate solution.
6. Add ammonium hydroxide until the solution is red to Congo Red paper.
7. Add, carefully, hydrochloric acid (1:2) until the solution is blue to Congo Red paper. Now add one drop of (1:2) hydrochloric acid in excess.
8. Pour the test solution into a small (125 ml.) separatory funnel, and rinse out the beaker into the funnel.
9. Add 5 drops of ethyl ether to the solution. Mix and cool the funnel under the water tap.
10. Prepare a cold mixture of 3 volumes of amyl alcohol and one volume of ethyl ether.
11. Add 10 ml. of alcohol-ether mix to the funnel. Stopper the funnel and shake well under the water tap. Set the funnel in a support and allow the two layers to separate. Run the lower (water) layer into a second separatory funnel.
12. Observe the upper (alcohol) layer, and proceed as follows: (1) if the alcohol layer is colorless, the cobalt content is less than 0.0025 oz. per gal. and the test is complete; but (2) if the alcohol layer is blue, continue to Step 13.
13. Drain the alcohol layer into a 100 ml. beaker.
14. Re-extract the water layer in the secondary separatory funnel with 10 ml. of amyl alcohol-ether as before, and drain the extract into the same beaker. Continue the extractions with fresh 10 ml. portions of alcohol-ether until the extract is colorless. (If 6 or more extracts are required, it may be advisable to start anew with a 1 ml. sample, and use only 5 ml. of perchloric acid.)
15. Place the beaker containing the extracts on a steam-bath or warm plate (80°C.), and allow most of the ether to evaporate. Cool.
16. Pour the amyl alcohol into a dry separatory funnel in order to separate any water.
17. Transfer the amyl alcohol to a 50 ml. volumetric flask and dilute to the mark with pure amyl alcohol (not the ether mix).

Estimation of the Cobalt

Photometric method. Obtain "% Transmittancy," and from the standard curve prepared below, find the "mg. Co."

Visual method. Compare the test solution with synthetic standards as prepared below.

Preparation of Standard Solutions

COBALT STOCK SOLUTION

Weigh 0.100 gram of cobalt metal (99.8% pure will do). Transfer it to a 100 ml. beaker. Dissolve the metal in 10 ml. of water, 20 ml. of hydrochloric acid and one drop of peroxide. Pour this solution into a 1 liter volumetric flask, rinse out the beaker into the flask and dilute to the mark with water. Mix well. 1 ml. = 0.1 mg. Cobalt.

COBALT STANDARD SOLUTION

By pipette, withdraw 100 ml. of Cobalt stock solution and transfer it to a second 1 liter volumetric flask. Add 10 ml. of hydrochloric acid and dilute to the mark with water. Mix well. 1 mg. = 0.01 mg. Cobalt.

Preparation of Curve

Photometer. Prepare a series of 100 ml. beakers, and pipette in various amounts of Cobalt standard solution (1 ml. = 0.01 mg. Co). Start with Step No. 3 above, and continue through No. 17. Use water as the blank, and obtain "% Transmittancy" readings for the various standards. Plot "% Transmittancy" as ordinate and "mg. Co" as abscissa on semi-log paper. (A yellow filter is suggested.)

Visual comparison. Proceed as written above, until the standards are obtained in the 50 ml. volumetric flasks. Compare the color of the test solution with that of the standards in matched test tubes or Nessler tubes. Estimate "mg. Co." (Copper sulfate solutions "nearly match" the standards.)

Calculation

Co, oz. per gal. = 0.0134 × "mg. Co."

Reference

Bayliss, N. S., and *Pickering, R. W.*, Ind. Eng. Chem., Anal. Ed., 18,446 (1946).

PRECISION POTENTIOMETRIC METHOD.

Range — 0.05 oz. per gal. or more.
Interfering elements — Manganese, Nickel, Tungsten, Iron and Chromium may all be present in large amounts without affecting results.
Special apparatus: a potentiometer with a platinum electrode and a glass or calomel electrode.

1. Size of sample. Choose a size of sample to contain not less than 4 mg. of Co, nor more than 200 mg. of Co. The total amount of metal ions present should not be greater than 1.5 grams. Pipette the chosen volume of test sample into a 400 ml. beaker.
2. Add 15 ml. of nitric acid and 20 ml. of perchloric acid. Cover the beaker and evaporate to heavy fumes of perchloric acid. Continue evaporating to the point where salts will appear when the beaker is cooled in air for 60 seconds. Cool to room temperature. Add 50 ml. of water.
3. If the solution is red, add 10 ml. of lead perchlorate solution (16 grams per 100 ml. of water); if the solution is green or just slightly pink, add only 5 ml. of lead perchlorate solution. Boil the solution for 2 minutes, then cool to 20°C., or less.

(*Continued on page* 66)

A New Coating Thickness Measuring Instrument

Figure 1. Photo of the instrument described in this article.

MEASUREMENT of the thickness of non-magnetic coatings on steel by magnetic methods has attained wide use during the past few years. Tests with these instruments are extremely convenient, non-destructive, and sufficiently accurate to enable both metal and organic finishers of steel products to economically exercise close dimensional control of their operations. This trend toward closer control of the metal finishing operation has stimulated the development of many different instruments which are dependent on the principle of measuring the force required to separate a magnet from the surface of the coated steel article and correlating this force with the thickness of the coating. These instruments differ from one another in the means by which the force is measured and in the type of magnet employed. It is interesting to note that practically all of the standard weighing mechanisms have been applied to these instruments. These devices include the spiral spring balance, torsion spring balance, the helical spring balance, and the standard beam balance. Permanent magnets, AC energized electromagnets, and DC energized electromagnets are the magnet types which have been used.

The development of the instrument described in this article stemmed from the desire to provide a simple mechanism for measurement of coating thickness that would be energized by standard 110 volt A.C. lighting circuit power, would be relatively insensitive to normal voltage variation in the power source, and would provide a means for rapid, yet accurate measurement.

The instrument in its present form (Figure 1) is what may be described as a totally electromagnetic device. The magnet is coupled to the instrument and held in suspension by an electromagnetic field. The weighing operation is performed by means of a self-compensating magnetic balance, and the field strength of the testing magnet is induced by the single solenoid, which is the source of magnetism for all these functions.

This instrument is operated by energizing the solenoid (110 volts, 60 cycles AC), grasping the knob at the end of the tube between the thumb and forefinger, and supporting it in a substantially vertical position over the article to be tested, with the lower end in contact with the coating being measured. The other fingers rest on the side of the graduated tube and help control the speed with which the solenoid is moved. Readings are obtained by lowering the solenoid (the heavy outer casing—Figure 1) until the core (inside the graduated tube) contacts the coating and then raising the solenoid until separation of the core from the coating has been effected. The scale reading is made by noting the position of the red plastic indicator attached to the upper end of the core with reference to the graduated tube.

The principle of operation which provides these readings may best be illustrated by a description of the magnetic forces involved. When the solenoid is being raised, the magnet is prevented from leaving the surface of the coated steel article because of the magnetic force acting between its pole and the steel base metal. Therefore, as the solenoid is elevated the magnet becomes further and further displaced from the center of its electromagnetic field. As a consequence, the back e.m.f. induced by the presence of the iron core becomes smaller, and the current flowing in the solenoid windings becomes greater. This results in an increase in the field strength of the solenoid. Before the magnet can be separated from its attachment to the specimen the upward pull exerted by the electromagnetic field must exceed the magnetic force acting between the pole of the magnet and the steel. When these forces approach a balance, the magnet in contact with the specimen begins to chatter at a frequency corresponding to the 60 cycle source, and at an amplitude

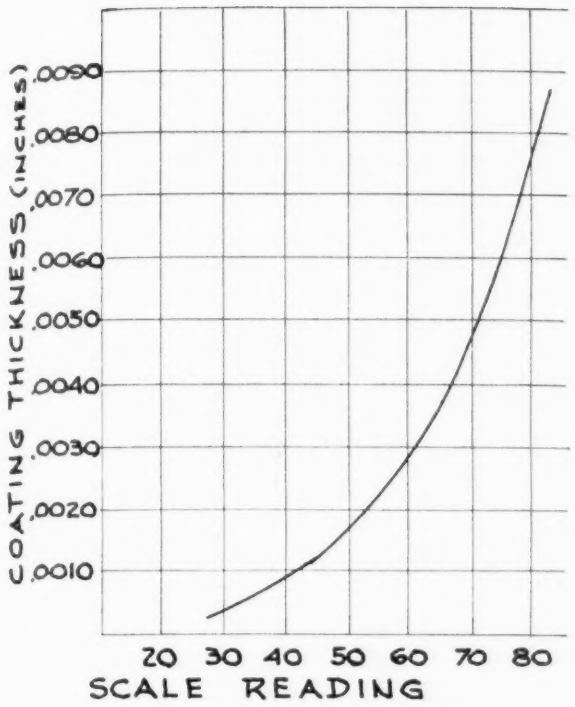


Figure 2. A typical calibration curve for this instrument.

depending on how nearly the solenoid position has reached the end point of the reading. The chatter occurs as the alternating current cycle passes through its zero value. This vibration, in addition to serving as an excellent warning signal, sets the core into a dynamic state which minimizes the effect of chance frictional forces due to contact of the magnet with the bore of the glass tube. It is noted that during the entire measuring cycle no mechanical motion comes in contact with the magnet, since the graduated tube remains motionless at all times. Figure 2 shows a typical calibration curve for this instrument.

Figure 3 is a schematic illustration of the physical distances involved in obtaining a coating thickness reading. The figure shows the solenoid and core in equilibrium position following separation of the core. The significant distances are labeled D_k (distance from the surface of the coating to the top of the indicator); D_1 (distance from the surface of the coating to the top surface of the solenoid); and D_2 (distance between the top of the solenoid and the top of the indicator.

A series of tests, which will be described later, showed that the distance D_k was relatively constant for a given coating thickness, regardless of applied voltage. It was thus possible to assume that the following relationship was essentially true

$$D_k = D_1 + D_2$$

If D_k is a constant, changes in the applied voltage will cause both D_1 and D_2 to vary so that the sum of these distances will always be equal to D_k. If the applied voltage is reduced, the distance D_1 becomes greater because it is necessary to raise the solenoid to a higher level before separation of the core will occur. At the same time the distance D_2 becomes compensatingly smaller because the weaker magnetic field cannot support the core at the same level as before. When the voltage is increased the changes naturally occur in the opposite direction.

A series of tests were made over the voltage range between 80 and 120 volts. Variation in the distance D_1 was noted in order to determine the effect of the change in applied voltage. This data was plotted in Figure 4 and designated as reading method "A." Another series of readings were made uring the distance D_k. This data was also plotted in Figure 4 and designated as reading method "B." The curve obtained from the latter set of data was substantially flat and was responsible for the assumption made before that D_k represented a relative constant. The results obtained with reading method "A" naturally varied greatly with change in applied voltage. According to this data, voltage variation between 80 and 120 volts will not significantly effect the accuracy of the determination if reading method "B" is used.

Although manipulation of the instrument is an extremely simple operation, a certain amount of skill is necessary to produce results of the desired precision. This skill is no more complex than that necessary for the operation of a micrometer or vernier calipers, nevertheless practice and familiarity with possible sources of error are necessary for best results.

When the solenoid is initially energized, the plastic indicator extends approximately one scale division higher than it does after the instrument has attained a thermal equilibrium (requires approximately 10 min.). The heating which occurs with energization raises the resistance of the copper wire in the solenoid and produces about the same effect as a reduction in the applied voltage. This condition is automatically corrected in the same manner as voltage variation in the power source. The rise in temperature of approximately 20-30° F. does not cause any discomfort to the operator of the instrument; however, the change does effect the magnetic properties of the iron core. This is reflected by an error in the calibration of approximately ½ scale division. The error ranges from 5% for the thin coatings to 2% for the heavier films.

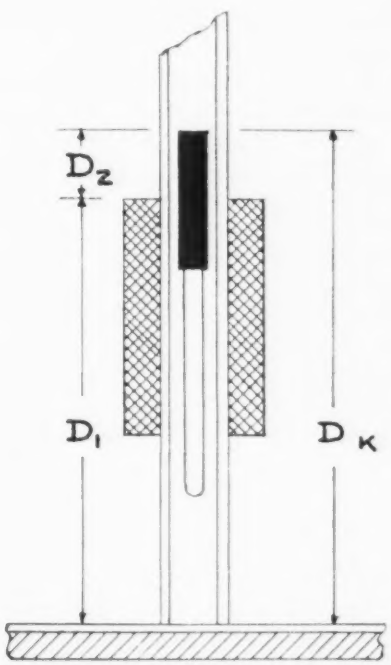


Figure 3. Schematic illustration of the distances involved in the making of the test.

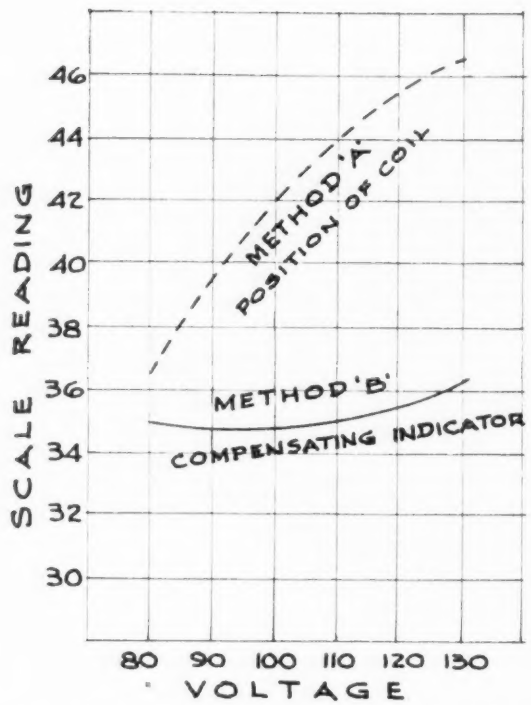


Figure 4. Effect of line voltage on the accuracy of the instrument.

For most applications this error is of little consequence. However, by energizing the instrument approximately ten minutes before use, its temperature attains its equilibrium value and the error is automatically erased.

The tip of the magnet and the articles to be tested must be kept clean and free from lint, oil, and water. Extremely rough electrodeposits will yield results dependent upon whether the magnet comes to rest on a high or low point on the surface. With this type of coating it is frequently well to burnish a small area to provide space to obtain the reading.

Another source of possible error is when measurements are attempted on articles that have been permanently magnetized in the course of the manufacturing process. Magnetic chucking and sometimes grinding operations are frequently the source of this magnetism and the article must be demagnetized before testing.

In common with all magnetic-type instruments, the nature of the basis metal has an influence on the validity of the calibration. However, a single calibration for non-magnetic coatings on mild steel should be satisfactory for almost all applications. Experience has indicated that error attributable to a marked difference in the composition and heat treatment of the basis metal is greatest for coating thickness under .001", and quite small for the heavier coatings. The instrument can of course be calibrated to suit any special requirement with reference to the character of the basis metal.

A final word of caution is given relative to the measurement of coatings on extremely thin or small components. Where the thickness of the basic metal is less than .015" it is advisable to conduct the test over a steel panel or block, so that the thickness of steel under the coating at least equals the .015". Very tiny parts are also tested most reliably if the same procedure is followed.

DETERMINATION OF IMPURITIES

(*Concluded from page 63*)

4. Prepare a 12.5 cm. No. 40 Whatman paper and half-fill it with paper pulp.
5. Filter the cold solution into another 400 ml. beaker and wash the paper with a cold wash solution which is 1% in perchloric acid and 1% in lead perchlorate. Cool the filtrate to 15°C. It is important that the temperature be less than 20°C.
6. To an 800 ml. beaker add 100 ml. of buffer solution (below) and 80 ml. of ammonium hydroxide.
7. By pipette add standard potassium ferricyanide (below). The amount of potassium ferricyanide must be in excess of the expected amount of cobalt present. (About 50 ml. of standard potassium ferricyanide will be equivalent to 100 mg. of cobalt. A large excess will not cause difficulties, only time waste.)
8. Cool the 800 ml. beaker to 15°C.
9. Slowly pour the cobalt solution (400-ml. beaker) *into* the buffer solution (800 ml. beaker), never the reverse. Stir continually. Wash the 400 ml. beaker with water, draining into the 800 ml. beaker.
10. Dilute the solution to 600 ml. with cold water and cool below 20°C.

Preparation of Standard Solutions

COBALT STANDARD SOLUTION

Weigh 2.004 grams of cobalt metal (usually 99.8%) and transfer it to a 300 ml. Erlenmeyer flask. Add 5 ml. of hydrochloric acid, 20 ml. of nitric acid and 25 ml. of perchloric acid. After action subsides, evaporate to heavy fumes of perchloric acid. Cool. Add 75 ml. of water and 5 ml. of hydrochloric acid. Boil for 5 minutes. Cool. Transfer the solution to a 1-liter volumetric flask, dilute to the mark with water and mix well. 1 ml. = 0.002 gram Co.

POTASSIUM FERRICYANIDE SOLUTION, INTERMEDIATE STANDARD

Dissolve 11 grams of the large crystals in 1 liter of water. Store in a dark bottle in a dark, cool place. This solution must be standardized once a week, and discarded after 21 days.

BUFFER SOLUTION

To a 2 liter beaker add 1 liter of water and 500 grams of citric acid. Place the beaker in a cooling bath and add, in small portions, 675 ml. of ammonium hydroxide.

Titration for Cobalt

The strength of ferricyanide solution is first determined. Pour into an 800 ml. beaker 100 ml. of buffer solution, 80 ml. of ammonium hydroxide, and, by pipette, 50 ml. of potassium ferricyanide solution. Dilute to about 600 ml. with water. Cool to 15°C. Set the beaker in the potentiometer, adjust the electrodes and slide wire and titrate slowly with standard cobalt solution. Observe the potential "jumps" near the equivalence point and determine the end point by graph or by calculation. 50 ml. of ferricyanide are found equal to this number of ml. of cobalt solution, and is called the Ratio Factor.

$$\text{Ratio Factor} = \frac{\text{ml. Cobalt solution}}{\text{ml. potassium ferricyanide}}$$

Take the test solution as prepared in Step 10, and titrate as in above. Record this "ml. back titration by cobalt solution."

Calculation

$$\text{ml. Co solution} = (\text{ml. potassium ferricyanide} \times \text{Ratio Factor}) - \text{ml. back titration by cobalt.}$$

$$\text{Co, oz. per gal.} = \frac{(0.267)}{\text{V, ml.}} \times \text{ml. Co solution}$$

where "V, ml." is the size of sample, in No. 1.

Reference

Dickens, P. and *Massen, G.*, Mit. Kaiser-Wilhelm Inst., 17,191 (1935).

(*To be continued*)

View of the analytical section of United Chrome laboratory.

United Chromium's Metal Finishing Laboratory

New Detroit Research Center has Modern Facilities for Servicing and Developing Firm's Products

IN these days of rapid technical advancement, a supplier in the metal finishing field must have a research laboratory and pilot plant capable of taking on almost any problem connected with metal finishing. With this fact in mind, *United Chromium, Inc.* designed their new Detroit laboratories. Housed in the new one story building are research and analytical laboratories, a pilot plant, sales offices, a special chemical mixing section, and shipping and storage facilities. The 120' x 142' building is situated on a large lot, allowing ample room for future expansion.

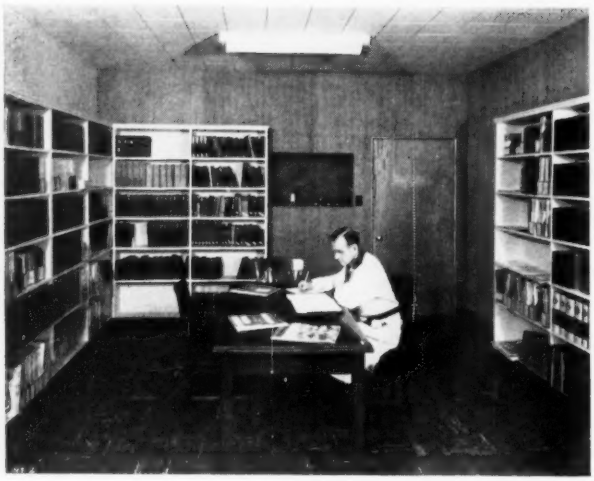
Office and administrative details are carried out in this area under ideal working conditions.

The new laboratories, one of three research units United Chromium maintains, cover 3000 square feet exclusive of the pilot plant and offices. They are equipped to carry out plating research on all of the common metals as well as some that are not so common. The laboratories also do work on anozinc and color plating processes, chemical dip treatments, metal strippers, rack coatings, stop-offs, buffing materials, cleaners, lacquers and synthetics, and a number of other allied metal finishing projects.

Adopt Unit Principle

T. G. Coyle, Vice President, and *Dr. J. E. Stareck*, Research Director, instructed their engineering department to design the research laboratories following the Unit Principle, with separate facilities for each research function.

Because of the broad scope of United Chromium's activities, they are obliged to carry out many diverse



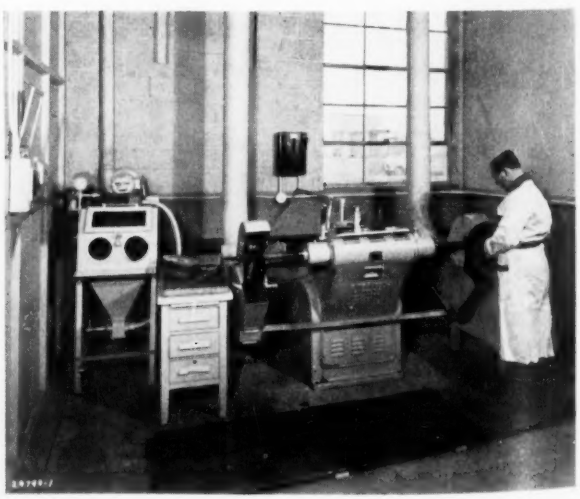
An extensive reference library enables the researcher to keep up with world-wide advances and to study previous work in the field.

One of the two electrochemical research units where electroplating baths are under study.

Special laboratory for research and technical service on the new SRHS chrome plating bath.

The pilot plating plant, where full-scale tests are made possible on new and existing processes.

One section of the new laboratory where special rack coating formulations are developed and tested.



Blast cleaning and polishing-buffing of test parts are carried out in this area, adjacent to the pilot plant.

projects simultaneously. Only by following the Unit Principle are they able to do this without the bottlenecks that frequently appear in large, multi-purpose laboratories.

The new facilities include six separate laboratories. There is a 15′ x 23′ Testing Laboratory for physical testing or treatment. The basic equipment of this laboratory consists of a controlled atmosphere furnace, an electric oven, a hydraulic specimen mounting press, an Elmes Hydraulic Press, and a Van Dorn Extrusion Molding Machine.

The General Research Laboratory, which is 13′ x 23′, is used for general plating and metal finishing research. It is equipped with a laboratory work bench, hood and service lines, plating test cells, including constant temperature bath, a small electric oven, and the usual miscellaneous laboratory equipment.

Two Plating Research Laboratories, 13′ x 23′, and an 18′ x 23′ Electrochemical Research and Testing Laboratory are used for specialized plating and metal treating research. The equipment in each of these laboratories is similar to that of the General Research Laboratory.

Analytical work on raw materials and plating solutions is carried out in a 15′ x 45′ analytical laboratory. Facilities are available for analyzing as many as 100 plating solutions a day. Included in its general analytical and plating test apparatus are hoods, balances, titration stands, pH meter, Kjeldahl Unit, carbon train, water still, salt spray cabinet, and a humidity cabinet.

While each laboratory contains analytical balances, the Engineering Department also set up a separate well-equipped 13′ x 15′ balance room where it will be least affected by moisture, vibration, or dust.

Power supplies for the laboratories include 110 and 220 volt AC plus special facilities for superimposed low voltage AC and 3 DC systems of 6 volts, 12 volts, and 50 volts. The laboratories are equipped with a wide variety of electrical controls and equipment, an oscilloscope, electrophotometer, and Brush Analyzer. Hot and cold water, water baths, gas, low and high pressure air outlets, and electric ovens have also been provided.

A special photography department is equipped with a metallographic microscope and camera and complete equipment for taking, developing, printing, and enlarging all types of photographs. It is common practice among United Chromium research engineers to supplement written reports with photographs that illustrate better than words the appearance of materials on which they are working.

Another important part of the research unit is the library. Book reviews and abstracts are studied regularly by several members from each section of the research staff. Pertinent literature is procured and indexed for future reference. The library contains many of the finest books on chemistry and metal finishing and an excellent abstract section. Complete files of certain American and foreign periodicals are maintained. Research engineers can obtain assistance with foreign publications from a regularly employed interpreter able to translate German, French, Spanish, Italian and Russian.

The Pilot Plant

The pilot plant is more fully equipped and larger than many commercial plating installations. It contains over 50 tanks and covers more than 2700 square feet. Current for these tanks can be drawn from an ample array of generators and rectifiers. The pilot plant has facilities for plating acid, cyanide, and pyrophosphate copper; Watt's nickel; several bright nickels; conventional chromic acid-sulfate chromium; barrel and still tank Self-Regulating High-Speed Chromium; cadmium; zinc; gold; silver; rhodium; tin; lead; Patternplate, and Electrocolor. Anozinc solutions and chromate-type dip solutions for producing conversion coatings on zinc and cadmium are available. There is also a tank for cleaning aluminum and facilities for stripping deposits of most of the previously mentioned metals. In addition to the exhaust systems on many of the tanks, there are six large roof ventilators equipped with renewable filters to clean the incoming air.

The pilot plant has a special organic coatings testing section for work on rack coatings, stop-offs, lacquers, and synthetics. This section is equipped with several dipping tanks, a dipping machine, a large spray booth, a baking oven, and a number of strip tanks. Renewable filters clean the air which enters this room. Although all organic coatings are formulated at the research laboratories of the company's Organic Coatings Division in Carteret, N. J., the Detroit Pilot Plant is called upon to evaluate all rack coatings and stop-offs under actual plating conditions. It also finishes many samples with their organic coatings for customers and prospects.

A fully equipped buffing room and machine shop are other important features of the pilot plant.

All equipment is painted with a chemical-resisting protective coating of the vinyl type. Cinder block walls and metal ceiling are painted with chlorinated rubber base coatings. These coatings, both manufactured by United Chromium, can be cleaned easily with a damp cloth, and have outstanding resistance to both acids and alkalies.

The new laboratories have a tradition to live up to. It was in the recently vacated Jefferson Avenue Laboratories in Detroit that many of the industry's widely used products and processes were developed or perfected. Among the important contributions of the old laboratory are Electrocolor and Patternplate, Unichrome Pyrophosphate Copper, Anozinc, Unichrome Dip Processes, and the Unichrome Self-Regulating High-Speed Chromium Plating Bath. The new laboratories will be devoted to the further improvement of these processes and to research in new metal finishing techniques.

Electropolishing With Hexafluorophosphoric Acid

By H. F. Martin* & Dr. C. B. F. Young, *Adj. Prof., Brooklyn Polytechnic Inst., Brooklyn, N. Y.*

Howard Martin obtained his B.S. in Chem. Eng. from Newark College of Engineering, and his Masters Degree from Brooklyn Polytechnic Inst. His plating experience was with Western Electric Co. as a finishing engineer, production manager of a large job plating shop, and in his present position as a sales engineer for the Frederick Gumm Chemical Co.

Abstract

THIS report concerns the feasibility of using hexafluorophosphoric acid as an electropolishing agent. For brightening brass, the following solution was found most satisfactory: 92.5-100 per cent HPF_6 (65% free HPF_6) and 0-7.5% water at current densities from 50 to 75 amps./sq. ft. (12 to 18 amps./sq. dm.); temperatures from 20 to 50° C. (68 to 122° F.). From five to 15 minutes polishing time is required.

Stainless steel can be polished in solutions containing 5-10% HPF_6, 39-50% water, and 38 to 45% H_2SO_4 (sp. gr. 1.835) at current densities ranging from 75 to 375 amps./sq. ft. (25 to 125 amps./sq. dm.). The temperature range is from 20 to 80° C. (68 to 176° F.) and polishing time from 5-15 minutes.

Nickel silver can be polished in solutions containing 85-92.5% HPF_6 and 7.5-15% water at current densities ranging from 100 to 2000 amps./sq. ft. (33 to 656 amps./sq. dm.). Polishing time varies from 5-15 minutes at temperatures from 20 to 80° C. (68 to 176° F.).

Hot rolled steel could not be polished satisfactorily using these materials.

Other miscellaneous addition agents were used. Materials of construction and costs are indicated.

Introduction

The purpose of this investigation was to determine whether or not hexafluorophosphoric acid could be used as an electropolishing agent for stainless steel, carbon steel, brass and nickel silver. The following acids used in combination with hexafluorophosphoric acid were also investigated: sulfuric acid, phosphoric acid, and chromic acid. Other miscellaneous chemicals were also used in various solutions.

In determining the usability of the various solutions studied, the following characteristics were investigated and observed:

1. Chemical composition of the baths.
2. Current density.
3. Temperature.
4. Polishing time.
5. Voltage.

In performing this investigation, effort was made to obtain satisfactory brightening effects at conditions simulating those generally experienced in metal finishing departments.

Experimental Method

The apparatus used in this investigation is illustrated in Fig. 1. The source of D. C. current was a standard selenium plate rectifier rated at 30 amps., 30 volts on the output side. The input voltage was 110 A.C. The D.C. voltage was very accurately controlled by means of a Powerstat and was read within the limited ±0.1 volt. A five-ampere meter was connected in series with the negative side of the circuit so that the very low current used in this work could be read within ±0.1 ampere.

A small alligator clip was brazed onto the ¼" × ¼" (.635 × .635 cm.) busbar. A slight protusion of the brazing material was used as a stop for the various metal samples in order to assure uniform depth of immersion. Since the acid used in this work attacks siliceous materials, glass containers could not be used. Polystyrene beakers were used as storage vessels for the solutions used in this investigation. The beaker in which these tests were performed was notched out to fit ¼" × ¼" (.635 × .635 cm.) busbar and thereby hold the bar in the same vertical position during each test run to further assure uniform depth of immersion and accurate current densities.

The cathod in all cases was a carbon rod ½" × 1½" × 3" (1.27 × 3.81 × 7.62 cm.), while the anodes were cut from the stock to be polished into 1" × 2" (2.54 × 5.08 cm.), strips. The metals used as anode included 18-8 stainless steel, nickel silver, low carbon steel, and brass. When the solution was operated below 40° C., (104° F.), it was necessary to provide heat by means of a Bunsen burner, for the heat liberated during electropolishing was not sufficient to maintain these temperatures.

Since this is an exothermic reaction, the temperature did rise slightly when the solutions were operated between the range 20-40°C (68-104°F.). This lack of temperature control indicated to some degree the thermal stability of the solution and it enabled the observer to note the effect of minor changes in temperature on the quality of the electropolished surface.

**Submitted in partial fulfillment of the required work for the degree of Master of Chemical Engineering at Brooklyn Polytechnic Institute.*

All of the work described herein was performed under an exhaust hood. This was necessary to remove the obnoxious fumes which were liberated from the solution.

No special facilities were used to determine or measure the degree of polish obtained. This was done by visual examination, since this investigation concerned itself with the determination of the usability of various solutions as polishing baths and not with a quantitative appraisal of various solutions.

Materials Used

1. 18-8 Stainless Steel, cold rolled, annealed dead soft: (18% Cr: 9.15% Ni: 0.1% C)
2. 18-1 Stainless Steel, cold rolled, annealed. (17-20% Cr: 7-10% Ni: 0.5% Mn: 0.5% Si: 0.2% C)
3. High Brass, annealed soft, cold rolled: (65% Cu: 35% Zn)
4. Nickel Silver, 12%, cold rolled, annealed soft: (Cu 65%: Ni 18%: Zn 17%)
5. Deoxidized Copper, cold rolled, annealed soft: (Cu 99.9%: P 0.01%)
6. Monel Metal, cold rolled, annealed soft: (Ni 60%: 33% Cu: Fe 6.5%)
7. S.A.E. 1020 Steel, hot rolled: (C 0.18-0.23%: Mn 0.30-0.50%: P 0.04%: S 0.05%)

Various acid concentrations

HPF_6 ..... Hexafluorophosphoric Acid (65.7% HPF_6)
H_3PO_4 ..... Phosphoric Acid, 85%
H_2SO_4 ..... Sulfuric Acid, 97%

Results

Hexafluorophosphoric acid and sulfuric acid solutions exhibited good polishing characteristics on 18-8 stainless steel. The limits of concentrations within which bright polishing can be produced ranges from 5-10% hexafluorophosphoric acid, from 39-50% water, and from 38-45% sulfuric acid (sp. gr. 1.835). Good polishing can be obtained at current densities from 75-375 amps./sq. ft., (25 to 125 amps./sq. dm.). The temperature range for these results is rather wide. 20-80°C., (68 to 176°F.). Polishing time can vary from 5-15 minutes, depending on the degree of polish desired.

In polishing stainless steel a slight amount of pitting was encountered, and several materials were used as addition agents in an effort to minimize this effect. These materials were glycerol, chromic acid, "Addition Agent XXX-D,[1] and various wetting agents such as "Saponate",[2] "Hydronate",[2] and Nacconal NR.[3] The use of the above mentioned agents did not show any changes in the results with respect to the degree of pitting or by influencing the quality of the polished surface in general.

The extent of pitting varied with the time of polishing. As the polishing interval was lengthened, the amount of pitting was increased. Apparently the only factor which influenced this condition was the solution temperature. Higher bath temperatures yielded surfaces with a minimum of pitting. In so doing, the conductivity of the solution and the viscous film were increased, the cell voltage was decreased, and the range of bright current densities was raised slightly.

On all samples of stainless steel which indicated good polishing characteristics, the individual samples emerged from the solution covered with a yellow to red viscous film which was soluble in rinsing water, but which required agitating the plate in order to penetrate the film and expedite clean rinsing. In commercial practice, two rinses would be required, preferably the cascading type generally found in most electroplating plants.

The passivity of the polished surface was checked by immersing several polished samples of stainless steel in an acidified solution of copper sulfate. As would be expected in the case of passive surfaces, no copper deposited on the samples. Photomicrographs of a sample polished by these methods can be seen in Fig. 2.

Aqueous solutions of hexafluorophosphoric acid alone did not produce any brightening effect on stainless steel. These baths yielded surfaces which were dull, or at best equivalent to a satin finish produced by conventional mechanical methods. The substitution of phosphoric acid for the sulfuric acid in the tertiary systems yielded results which indicated a tendency to brighten, but were not comparable to those samples produced in the sulfuric acid-hexafluorophosphoric acid-water solutions.

Polished surfaces could not be produced on hot-rolled steel using any of the following baths: hexafluorophosphoric acid; hexafluorophosphoric acid-water; hexafluorophosphoric acid-water-sulfuric acid; hexafluorophosphoric acid-water-phosphoric acid. Solu-

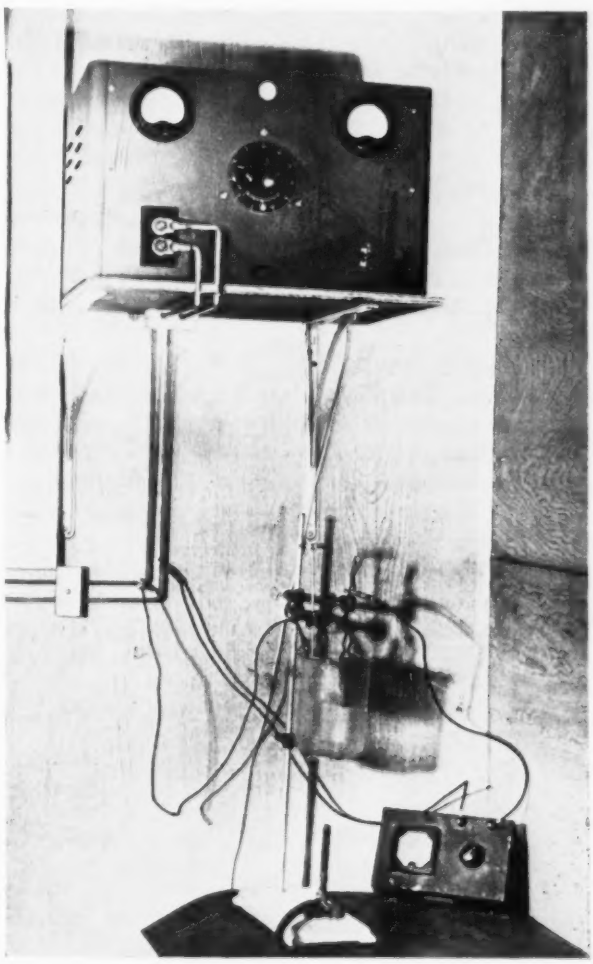


Figure 1. Test apparatus used for investigating the polishing characteristics of the various baths.

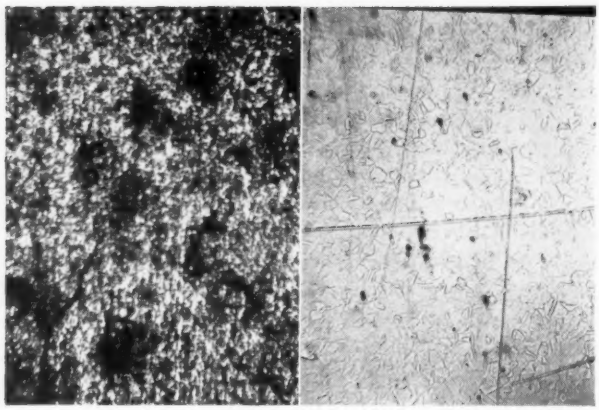


Figure 2. 18-8 stainless steel electropolished in 7.5% HPF_6 + 50% water + 42.5% H_2SO_4 at 100 amps./sq. ft. for 5 minutes at 176°F. (Left) Unpolished surface; (right) After polishing.

tions containing 55% or more of hexafluorophosphoric acid polarized to such an extent that no appreciable current was conducted at a potential of 30 volts. However, when such a solution was diluted with water good conductivity resulted, as was done with some samples, no polishing effect was obtained. The only effect produced on hot-rolled steel was etching, which was intensified as the current density was increased, the temperature was decreased, or the immersion time lengthened.

High brass was polished with fair results in aqueous solutions containing 92.5-100% hexafluorophosphoric acid. Relatively low current densities were used to produce these results, namely, 50-75 amps./sq. ft. (12 to 18 amps. sq. dm.). Bath temperatures ranging from 20 to 50°C. (68 to 122°F.) produced best results and polishing time varied from 5-15 minutes with better polishing resulting from increased time.

Excessive polarization was apparent in the solutions used on brass, and was indicated by sharp increases in voltage. Conversely, polarization was readily decreased as the temperature was raised, which is to be expected.

The general polishing effect on brass could only be considered as fair and not comparable to results produced by mechanical polishing methods. It might well be considered equivalent to those results obtained by immersing brass in conventioned "bright dipping" solutions. Photomicrographs of these results can be found in Fig. 3.

Nickel silver can be polished with good results in solutions containing 85-92.5% hexafluorophosphoric acid and 7.5-15% water. With nickel silver a very wide range of current densities was possible, 100-2000 amps. sq. ft. (33 to 656 amps./sq. dm.). The temperature could also be varied within rather wide limits, 20-30°C. (68-176°F.). Good polishing results were obtained with immersion time from 5-15 minutes.

Concentrated hexafluorophosphoric acid could not be used on nickel silver because of the extremely high degree of polarization. Low acid concentrations were also tried, with poor results on nickel silver. Photomicrographs of nickel silver polished with the solutions described above are given in Fig. 4.

In this investigation hexafluorophosphoric acid concentrations were maintained so that the free HPF_6 content was kept below 10% and above 50%. In the range from 10-50% HPF_6, the PF_6 ion reacts extensively with water, so that within a very short interval of time the HPF_6 content will diminish to 3-10%. Below 10% the acid is quite stable and can be stored for long periods of time without change.

Bath Life

The observed operating life of these solutions is comparatively long, for the metal dissolved at the anode is simultaneously deposited at the cathode. With all the various solutions used in this investigation, it was apparent that deposition was occuring simultaneously with dissolution of the anode. After making 10-15 test runs, it was necessary to remove the cathode and scrape off the metal deposited on it to prevent this loosely-adherent metal from falling into the solution and possibly causing deleterious effects on polishing.

One 150 ml. bath containing 7.5% of HPF_6, 49.7% of H_2O, 42.8% of H_2SO_4 was used for 446 ampere-minutes polishing stainless steel and was still polishing highly satisfactorily when it was discarded. Using 13 ampere-minutes for two square inches of stainless steel, this would indicate that at least 68.6 square inches were polished with this 150 ml. portion of solution. A conversion of these figures would indicate that the solution described above would be capable of polishing at least 12 square feet of stainless steel per gallon.

A freshly prepared aqueous solution containing 60% hexafluorophosphoric acid was used to polish brass. This bath was used for 270 ampere-minutes before it was discarded. However, it was still polishing satisfactorily at that time. Using nine minutes as a basis for each two square inches of brass polished, this would indicate that this solution could be used with satisfactory results for sixty square inches per 150 ml. Similarly, one gallon of the above solution would polish at least 11 square feet of brass.

A 150 ml. bath containing 55% HPF_6, 45% water was used to polish nickel silver for 736 ampere-minutes and was producing good results at this point. Using 10 ampere-minutes for each two square inch sample of nickel silver, 73.6 square inches could be polished satisfactorily. Thus, thirteen square feet of metal could be polished per gallon of solution.

The main source of loss is by evaporation of the

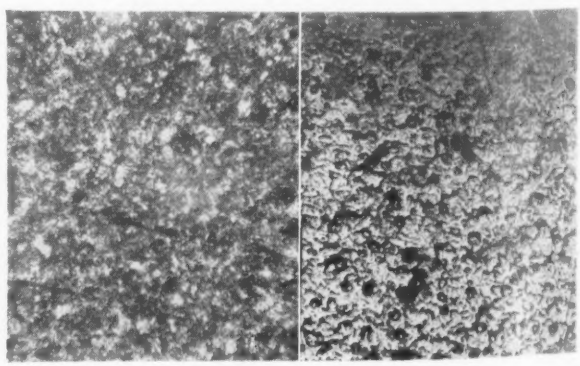


Figure 3. Electropolished high brass. Specimen at left is before polishing. Conditions of polishing were: 92.5% HPF_6 + 7.5% water at 75 amps./sq. ft. for 10 minutes at 68°F.

water and hexafluorophosphoric acid. To overcome this, the solution level should be maintained by adding quantities of these components corresponding to the proportions of each lost by evaporation. Another means by which the solution level is lowered is dragout. Obviously, make-up solution must be added periodically in order to maintain satisfactory operating conditions.

Theory of Polishing with Hexafluorophosphoric Acid

The mechanism of polishing is apparently quite complex because of the presence of several different fluorine compounds in the bath at the same time. A portion of these compounds are in the hexafluorophosphoric acid, since it is apparently not possible to isolate HPF_6. An average analysis for the hexafluorophosphoric acid is as follows:

HPF_6	65%
HF	6%
Mixture of HPO_2F_2, H_2PO_3F, H_3PO_4	3%
Water	21%

Additional quantities of these compounds are formed as hydrolysis takes place. The hydrolysis of hexafluorophosphoric acid occurs in three steps as follows:

1. $HPF_6 + 2H_2O \rightarrow HPO_2F_2 + 4HF$
2. $HPO_2F_2 + H_2O \rightarrow H_2PO_3F + HF$
3. $H_2PO_3F + H_2O \rightarrow H_3PO_4 + HF$

Summarizing Equations 1, 2, and 3:

4. $HPF_6 + 4H_2O \rightarrow H_3PO_4 + 6HF$

Very likely any or all of these hydrolysis reactions occur simultaneously. Since no tests were available which would indicate the presence of the PF_6 ion in the presence of H_3PO_4, HPO_2F_2, H_2PO_3F, and H_2SO_4, it was necessary to use another method to determine whether or not the characteristics of these solutions were the same as those which would prevail if complete hydrolysis took place.

It was determined that there was enough water available in the following solution to cause complete hydrolysis of the hexafluorophosphoric acid contained therein.

Solution Composition

7.5% HPF_6, 49.7% Water, 42.8% H_2SO_4

Calculations

$7.5 \times .65 \times 1.65 = 8.05$ grams HPF_6

$7.5 \times .21 \times 1.65 = 2.60$ grams water

$\frac{8.05}{146} \times 4 \times 18 = 3.97$ grams water required to hydrolize HPF_6.

$\frac{8.05}{146} \times 6 \times 20 = 6.6$ grams HF formed.

$\frac{8.05}{146} \times 98 = 5.4$ grams H_3PO_4 formed.

$8 \times .85 \times 1.71 = 4.84$ grams H_3PO_4 present as impurity in the HPF_6.

Assuming complete hydrolysis, the original solution would contain the following:

H_3PO_4	$5.4 + 4.84 = 10.24$ grams
HF	5.4 grams
H_2SO_4	$42.8 \times .96 \times 1.835 = 75.4$ grams
H_2O	$49.7 - 2.6 - 3.1 - 3.97 - 42.8 \times .04 \times 1.835) = 51.4$ grams.

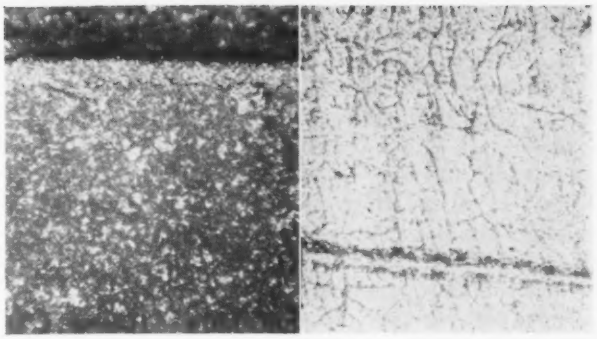


Figure 4. Electropolished nickel silver. Specimen at left unpolished. Conditions of polishing were: 92.5% HPF_6 + 7.5% water at 200 amps./sq. ft. for 5 minutes at 85°F.

A new solution was then made using the above quantities. Using the same current density, time and temperature as were used with the original solution, a piece of stainless steel was polished. The resulting surface indicated a definite brightening but it was not comparable to that obtained when the bath was used containing hexafluorophosphoric acid.

The foregoing results appear reasonable when it was considered that the free HPF_6 content of the bath is only 4.9%, which is in the concentration range of maximum stability for this material.

MATERIAL DATA

HEXAFLUOROPHOSPHORIC ACID	
Specific Gravity	1.65
HPF_6 content	65%
SULFURIC ACID	
Specific Gravity	1.835
H_2SO_4	96%
PHOSPHORIC ACID	
Specific Gravity	1.71
H_3PO_4	85%

Economics of the Method

Hexafluorophosphoric acid is not yet being produced commercially.* although it is available for experimental uses. The manufacturer plans to produce this material in commercial quantities when the demand warrants such increase in the scale of operations. On the basis of pilot plant production results, it seems probable that hexafluorophosphoric acid will cost about forty cents per pound, F.O.B., Tulsa, Oklahoma. Commercial shipments will be made in aluminum drums containing 150-200 pounds of acid.

For polishing stainless steels it seems apparent that a solution using hexafluorophosphoric acid would be considerably cheaper than those currently being used for this purpose. For example, a solution containing 7.5% Hexafluorophosphoric acid, 42.5% Sulfuric acid, and 50% Water would cost approximately 35 cents per gallon. However, a solution presently being used containing 60% Phosphoric acid, 20% Sulfuric acid, and 20% Water costs approximately 98 cents per gallon. Despite the relatively high cost of hexafluorophosphoric

*[*June 1949*]

acid, the cost per gallon of polishing solution is considerably lower because of the large proportion of water which this solution contains.

The cost of a solution for polishing nickel silver differs widely from that used for a stainless steel. For example, a solution containing 85% Hexafluorophosphoric acid and 15% Water would cost approximately $3.30 per gallon, which is extremely high for such a solution. Similarly, a solution containing hexafluorophosphoric acid used for polishing brass would be very expensive; 95 per cent hexafluorophosphoric acid, and five per cent water would cost approximately $3.70 per gallon. Obviously, the disadvantages lie in the use of such very high percentages of hexafluorophosphoric acid.

Patents were not taken into consideration here and their effect would alter these prices somewhat.

Materials of Construction

Due to the rapid rate of attack by hexafluorophosphoric acid on silicates, the solutions used in this work should not be stored or used in glass vessels.

Concentrated hexafluorophosphoric acid may be stored in vessels of aluminum, magnesium, silver or silver-lined, platinum, polyethylene, polystyrene, "Karbate," and "Haveg 48." In lower concentrations of acid, aluminum is unsuitable.

Probably the most suitable containers to be used for storing the electropolishing solutions mentioned herein should be made from polystyrene or polyethylene. These materials are satisfactory under any conditions except at higher temperatures (approximately 75°C.) where deformation of the plastic might occur. Polyethylene is superior to styrene in regard to porosity; the latter permits slow escape of the acid through the walls. For concentration below 50%, hard rubber vessels are good. Rubber-lined tanks would also be satisfactory, especially in the lower concentrations. Various materials may be used as a coating over base metals with satisfactory results: paraffin wax, ceresin wax, asphalt or mineral pitch, etc.

Conclusions

The use of hexafluorophosphoric acid as an electropolishing agent has been investigated and the following results obtained:

1. For polishing stainless steel, the following baths are recommended:
   a). Five to ten per cent hexafluorophosphoric acid (65% free HPF_6): 38-45% sulfuric acid (sp. gr. 1.835); and 39-50% water, with a current density of 75-375 amps./sq. ft. (25 to 125 amps./sq. dm.) at temperatures from 20-80°C. (69 to 176°F.) for 5-15 minutes.
   b). Aqueous solutions of hexafluorophosphoric acid alone can not be used to polish stainless steel other than to produce a dull, satin finish.
   c). Solutions containing phosphoric acid in place of the sulfuric acid showed a slight tendency to brighten, but were not comparable to the results obtained by using the solutions described in "a" above.
   d). Best polishing results on stainless steel indicated traces of pitting on the surface which were minimized by increasing the temperature. Addition agents and wetting agents had no effect on this condition.
2. Hot-rolled steel could not be polished with solutions containing hexafluorophosphoric acid.
3. The following solutions could be used to polish brass with fair results:
   a). 92.5-100% hexafluorophosphoric acid, balance water, with current densities from 50-75 amps./sq. ft. (12 to 18 amps./sq. dm.). Temperatures ranged from 20-50°C. (68-122°F.) and polishing time from 5-15 minutes.
4. The following solutions were found to produce good results on nickel silver:
   a). 85-92.5% hexafluorophosphoric acid, balance water. Current densities varied from 100-2000 amps./sq. ft. (33 to 656 amps./sq. dm.) at temperatures from 20-80°C. (68 to 176°F.). Good polishing was obtained in 5-15 minutes.
5. Hexafluorophosphoric acid produces results which are satisfactory for electropolishing. Equivalent results can not be produced using hydrofluoric acid and phosphoric acid in the proportions which would be found if hexafluorophosphoric acid hydrolyzed.

References

1. Harshaw Chemical Co., Cleveland, O.
2. Petroleum sulfonates. L. Sonneborn & Sons, Inc., New York, N. Y.
3. Alkyl aryl sulfonate. National Aniline Div., General Chemical Co., N. Y. C.

Compression Distillation for Plating Water Supply

By Joseph B. Kushner, *Consulting Engineer, Stroudsburg, Pa.*

A NUMBER of papers have appeared in recent years on the use of pure water in the plating room.[1, 2, 3, 4, 5] All have pointed out the advantages accruing from the use of such water in the plating baths and in the rinses between baths. In these discussions the emphasis has been on de-ionized water, and rarely, if ever, has distilled water been mentioned in this connection.

The use of de-ionized water by the plating industry in preference to distilled water is only natural because of the large cost differential between them. Yet the writer recalls that prior to the introduction of modern commercial water de-ionizing processes he pioneered in installing several gold plating plants in which distilled water was used exclusively. Because extra fine results were desired and were obtained with the use of distilled water, it paid to make use of it at the very high cost of 2½¢ a gallon! With the introduction of modern de-ionizing treatments for water, distillation as a method for obtaining pure water in the plating room has gone into complete eclipse. Pure water at .02 to .2 cents a gallon is lot more practical!

During the war years a more efficient form of distillation, known as "compression distillation," was given some development work in this country because of the great need for a better shipboard still. This work resulted in a highly efficient apparatus for converting sea water into super-pure potable water. The basis for the high efficiency of the process is its more effective use of heat energy, as indicated in the schematic drawing of Figure 1.

Raw water introduced as feed is initially heated to boiling in chamber C, using the auxilliary heater H. As soon as steam is produced it is compressed in the compressor P, where its temperature is raised from 212° to approximately 224°. The compressed steam now passes into the heat exchanger in chamber C where it gives up its heat to raise the temperature of the raw water to the boiling point and thus produce more steam. The condensed steam (distilled water) then passes through a highly efficient external heat exchanger where it preheats the feed water and is itself cooled to room temperature.

The main feature of this novel system is efficient utilization of heat energy, and because of it, a lower cost per gallon is possible than with any other method of distillation. Disregarding the cost of the raw water itself, which may run from 10 to 20 cents per 1000 gallons, the cost of the energy used to transform the water to a pure state runs about $1.00 per 1000 gallons on the larger installations, where a diesel-engine-operated compressor is used, or in areas where cheap electric power permits the use of an electrically-driven compressor. The first cost of the equipment, on a gallon for gallon basis, is higher for a compression still than for an ordinary still. This fact is mollified by the long life of the equipment, which permits amortization over a 15 to 25 years period, and the fact that heat efficiency remains high over a fairly long period of time; cleaning of the equipment is required at from 3 to 6 month intervals, depending on the feed water used. Figure 2 shows an actual commercial installation of a compression still.

Since, as can be seen from the comparative figures just given, the cost of compression-distilled water is still considerably above the price range of de-ionized water, it can be logically asked: "What advantage would this type of pure water source have over de-ionizing in the plating room?" The answer is that simply as a source of pure water, compression distillation has no advantage and it definitely cannot meet the price competition of de-ionization. *However, as a concentrator of dilute solutions and waste waters, the compression still is very possibly a good bet for the plater because it can do two jobs for the cost of one!* In other words, the water fed to the compression still does not have to be water right from the tap. It can be a solution that needs concentration, or waste water that requires a reduction in volume. With this thought in mind several possibilities present themselves for the use of a compression still in the plating room. One of these possible uses, recovery of dragout losses from valuable solutions, will be discussed at the present time.

Dragout Recovery

Consider a plating bath followed by a standing recovery rinse or dragout tank. This is almost standard practice in many plants where the plating bath is a valuable solution such as gold, silver or rhodium, or where the bath contains high concentrations of less valuable metals. The basic principle here is that the valuable solution coming off the work as dragout is

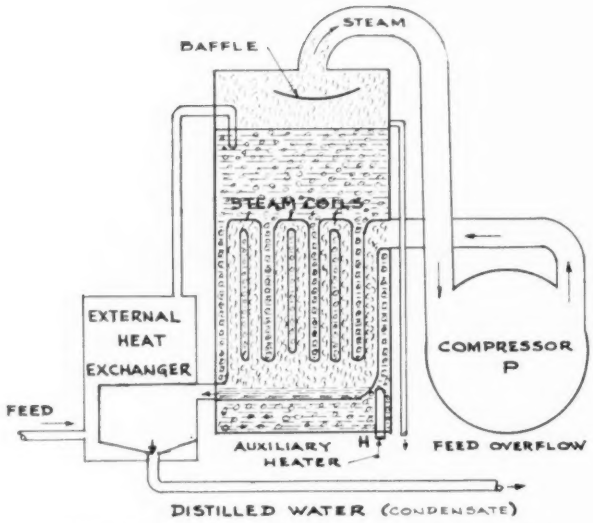


Figure 1. Principle of operation of a compression still.

picked up and held in the recovery tank. This dragout recovery water is supposed to be poured back into the pleting tank at frequent intervals, but often in actual production—human nature being what it is—this is not actually done, and as a result the recovery rinse tank becomes just another intermediate step in the passage of the plating bath to the sewer system.

To overcome this weakness, some ingenious systems for automatically feeding back the dragout solution to the plating tank have been devised. One such clever arrangement, proposed by *Jernstedt*,[7] makes use of float valves, an electrical contact switch, and a pump. Automatically, as the plating bath level drops, dragout solution is pumped back in to re-plenish the loss, and fresh tap water takes the place of the displaced dragout solution.

Such a system is not truly a continuous one, but is intermittent in nature. Nevertheless where a large volume of work is going through it, it is close enough to a continuous system to justify its analysis on that basis.[2] If we assume that the concentration of salts in the plating bath is kept constant at the value C_o, then after a period of operation a "steady state" condition is arrived at in which the weight of salts entering the recovery tank through drag-in is equal to the weight of salts leaving by being pumped out and by drag-out. Or mathematically speaking

$$\ominus C_o = (E + \ominus)\, C_r \quad \text{where} \qquad (1)$$

$\ominus$ is the average dragout vol. per minute

E is the volume of solution pumped out of the recovery tank per minute (the plating bath evaporation rate in gals. per minute)

C_o is the concentration of salts in oz./gal. in the plating bath, and

C_r is the concentration of salts in the recovery tank.

The concentration of the salts in the recovery rinse therefore becomes equal to

$$C_r = \frac{\ominus C_o}{E + \ominus} \qquad (2)$$

The loss of material from the plating bath per minute is equal to $\ominus C_o$ ounces, and what is returned per minute is EC_r or $\frac{E \ominus C_o}{E + \ominus}$, so the efficiency of this recovery system is equal to

$$\frac{E \ominus C_o / \ominus C_o}{E + \ominus} \times 100 = \frac{100E}{E + \ominus} \qquad (3)$$

The evaporation rate per sq. ft. of plating tank surface will vary with the temperature of the solution and the relative humidity of the air, among other things, from about .0005 gpm at room temperature to a figure somewhere around .007 gpm near the boiling point. These are admittedly rough figures, but are accurate enough to give us some idea of the possibilities.

Let us take the specific case of a gold plating solution in a tank 10 sq. ft. in surface area, operating on a production line where 2 loads go through per minute and the dragout per load is .01 gallon. If the evaporation rate is .002 gpm per sq. ft. of tank surface, then the total evaporation per minute is .02 gallons, and the efficiency of the recovery system is

$$100 \times \frac{.02}{.02 + .02} = 50\%$$

If the gold plating tank were only 5 sq. ft. in area the efficiency would drop to only

$$100 \times \frac{.01}{.01 + .02} = 33\%$$

To recover more of the gold solution a second recovery rinse tank in series with the first could be used, applying the same automatic pumping arrangement. The efficiency of recovery using 2 such tanks is readily found to be by analysis,

$$\frac{E^2 + E\ominus}{(E + \ominus)^2 - E\ominus} \times 100 \qquad (4)$$

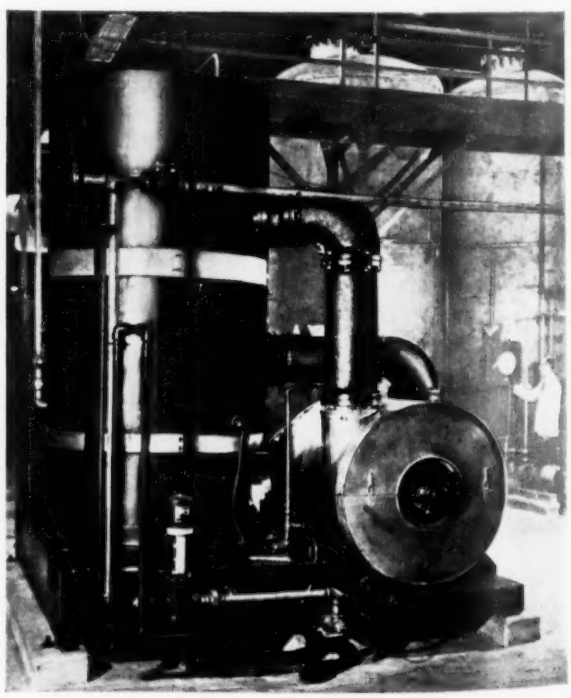


Figure 2. Commercial installation of a compression still.

Using the figures of the first example, the efficiency would now be raised from 50% to

$$\frac{(.02)^2 + .02 \times .02}{(.04)^2 - .02 \times .02} = 66\%$$

For a 3 tank system the efficiency would be raised to 75%.

Now consider the recovery system, using a compression still, indicated in Figure 3. "Q" gpm of water produced by the still are divided in flow so that E gpm flow back into the plating tank through a recovery rinse as before and the balance of G gpm flows through a second running rinse tank and back to the compression still to become part of the feed water. The excess feed, "F_1", is led into 1 of 2 storage tanks S_1 and S_2.

In order to produce 1 gpm of distilled water 1.1 gpm of feed water are needed. This is the minimum amount of feed that can be used to keep the system in equilibrium, according to the makers of this equipment. Let us assume we have a still with a capacity of 2 gpm; according to this our initial feed of tap water will be 2.2 gpm. Once the system is in operation and we start feeding back "G" gpm (disregarding small evaporation loss) we will only need a raw tap water feed of "F", which is equal to:

$$1.1\ (E + G) - G, \text{ or} \qquad (5)$$
$$1.1\ E + .1\ G$$

The amount of gold solution going back directly into the gold plating tank will be as before for a single recovery tank. The concentration of gold leaving the system as dragout from the second rinse tank will be equal to

$$C_p = \frac{\ominus C_r}{\ominus + G} \qquad (6)$$

and since $C_r = \dfrac{\ominus C_o}{\ominus + E}$, then

$$C_p = \frac{\ominus^2 C_o}{(\ominus + E)(\ominus + G)} \qquad (7)$$

The total amount of gold salts leaving the system therefore will be $\ominus C_p = \dfrac{\ominus^3 C_o}{(\ominus + E)(\ominus + G)}$, and the percentage lost from the system will be

$$\ominus C_p / \ominus C_o \times 100 = \frac{\ominus^2}{(\ominus + E)(\ominus + G)} \qquad (8)$$

Using the figures given previously, the gold salts lost from the system in terms of percentage is equal to

$$100 \times \frac{(.02)^2}{.04 \times 2} = .5\%$$

Thus the system recovers 99.5% of the gold salts, of which 50% goes back directly into the plating tank and 49.5% goes into the storage tank.

The equilibrium concentration of gold salts in the still during operation will be equal to

$$C_e = \frac{GC_p}{F} = \frac{GC_p}{1.1E + .1G} \qquad (9)$$

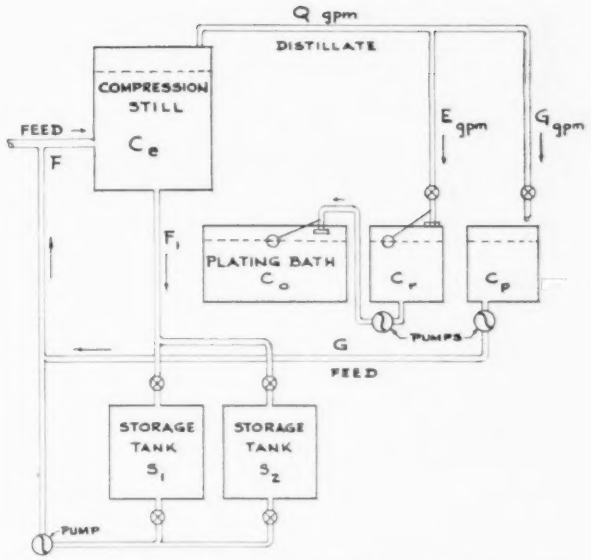


Figure 3. Diagram illustrating the possible application of a compression still to the recovery of gold from a high production plating line.

once the rinse water, "G", is fed back to the still. Substitution of the actual values shows that the concentration of the gold salts in the still will be equal to

$$C_e = \frac{1.98C_p}{.022 + .198} = 9C_p \qquad (10)$$

Or in other words the solution that flows into the storage tank will be 9 times more concentrated in gold salts than the solution in the second rinse tank.

This concentration of gold will not be great enough to warrant precipitation in the storage tank, so at the start of the next day's operation (assuming an 8 hour day), the contents of storage tank S_1 will be made the still feed (a small amount of fresh tap water will also be required to make up for losses, but this will be disregarded at the moment). If this is done then the equilibrium concentration of gold salts in the still after a period of operation will be given by

$$C_e = \frac{2G\ C_p}{F} \qquad (11)$$

and this will be the concentration of gold salts being stored in storage tank S_2.

If the contents of storage tank S_2 are used as feed the next day and S_1 becomes the run off tank, then the concentration of gold salts in the still at equilibrium becomes equal to

$$C_e = \frac{3G\ C_p}{F} \qquad (12)$$

The process can be continued in this way for m days and at the end of the mth day the concentration of gold salts will be given by

$$C_m = \frac{mGC_p}{F} \qquad (13)$$

Thus it can be seen that the concentration of the gold salts can be increased within the limits of solubility to any desired value before the gold in the storage tank

need be recovered. The calculations given are only approximate since allowance must be made for solids content and outside evaporation losses which was not done here. Nevertheless, it does show the beauty of the method for recovering and concentrating valuable metal salts. It is in essence like a savings bank, in which we make a daily deposit of a few dollars and then when we are ready, at the end of a period of time, we can draw out a goodly sum of money and start the process all over again!

Getting back to our example of the gold plating bath, let us assume that the gold plating bath when made up has the following composition: Potassium aurocyanide ($KAu(CN)_2$) 1 oz. per gal., potassium cyanide 1 oz. per gal. and potassium carbonate 2 oz./gal. The salt with the lowest solubility is the gold salt, since the maximum concentration it can achieve at room temperature, before precipitating out, is approximately 2 oz. per gal. This being so, how many days of operation of the system will be required to reach this gold concentration in a storage tank?

By the preceding equation (13)

$$m = FC_m/GC_p$$

From (7)

$$C_p = \frac{(.02)^2 \times 1}{.04 \times 2} = .005 \text{ oz./gal.}$$

$$\text{so, } m = \frac{.22 \times 2}{1.98 \times .005} = 44.5 \text{ days.}$$

Actually, it probably would be more desirable to precipitate the gold in the storage tank before it reached this high concentration in order to avoid the possibility of scaling the heat exchanger tubes.

If desired, after the end of the day's operation the entire contents of the still can be run off into the storage tank for the next day's operation and in the approximately 16 hours off time the still can be operated in the regular way to produce close to 2000 gallons of distilled water which can be stored in a storage tank and then used during the operating day for all bath make up and rinsing purposes, following the minimum rinse water usage systems proposed by the writer in another paper.[8] Such a mode of operation is possible because the still can be operated continuously 24 hours a day with a minimum of attention. At the start of the next day's operations, the tap water can be flushed out of the still and the contents of the gold storage tank restored, to continue the gold recovery cycle.

The question now arises, "This is all very nice, but would it apply to my case?" The answer is that actual cost calculations based on the known facts that apply to your case must be made in order to determine whether or not such a system is practical for you to use. For example, in the automatic gold plating installation which has been discussed here suppose there is room for only 2 recovery rinse tanks on the line? If a system such as the continuous evaporation replenishment method is used, under the fixed conditions the efficiency of recovery will be 66%, and the daily loss of gold (based on a $31.80 per oz. of gold) would be close to $70 a day. Under these circumstances, the still which would save practically the whole of this loss, would pay for itself in less than a year! (A still of 2 gpm capacity runs about $14,000 in cost.)

On the other hand, if the dragout rate were only .002 gpm for this set up, the two tank system would be about 99% efficient, and the daily loss would be about 22 cents, so the use of a compression still recovery system would not be justified.

In between these two extremes will be found cases for and against the use of a compression still in the plating room in connection with valuable metal recovery: the ratio of the evaporation loss "E" to the dragout loss "$\ominus$" is the all-controlling factor which must be determined in advance for calculations to be made regarding the practicability of a compression still.

Bibliography

1. *G. B. Hogaboom*, Metal Industry, 37, 165 (1937).
2. *Joseph B. Kushner*, Mo. Rev. Am. Electroplaters Soc. 29, 751 (1942).
3. *J. A. Roberts*, Met. Fin. 40, 415 (1942).
4. *F. R. Morral*, Met. Fin. 44, 472 (1946).
5. *W. S. Morrison*, Mo. Rev. Am. Electroplaters Soc. 30, 702 (1943).
6. Metal Industry, Jan. 1935.
7. *George W. Jernstedt*, p. 68, 36th Annual Proc. American Electroplaters Soc. 1949.
8. *Joseph B. Kushner*, Met. Fin. 47, 52 (1949).

ADDITIVE COMPOUNDS

(*Concluded from page* 58)

C. Marie and R. Audubert—*The Over-Voltage Phenomenon of the Addition of Colloids During Electrolysis;* Société Français des Eléctriciens, Bulletin, Series 4, Vol. 3 (1923), P. 508; or Science Abstracts, Vol. 27 A (1924), P. 359.

W. Blum and H. S. Rawdon—*The Chrystalline Form of Electrodeposited Metals;* Trans. A.E.S., Vol. 44 (1923), P. 397.

H. J. S. Sand—*The Role of Colloids in Electrolytic Metal-Deposition;* British Association for Advancement of Science, Report on Colloid Chemistry, Vol. 4 (1922), P. 346.

C. J. Wernlund—*Studies of the Zinc Cyanide Plating Solution;* Trans. A.E.S., Vol. 40 (1921), P. 257.

F. C. Mathers—*Lead Plating from NaOH Lead Baths by the Use of Addition Agents;* Trans. A.E.S., Vol. 38 (1920), P. 121; or Met. Ind., (Oct., 1920), P. 467.

W. Blum—*Factors Governing the Structure of Electro-Deposited Metals;* Trans. A.E.S., Vol. 36 (1919), P. 213.

E. F. Kern—*Electrolytic Refining of Tin;* Trans. A.E.S., Vol. 33 (1918), P. 155.

F. C. Mathers and A. B. Leible—*Essential Oils as Addition Agents in Plating Baths;* Trans. A.E.S., Vol. 31 (1917), P. 271.

N. K. Chaney—*Contact Resistance of Metal Electrodes;* Trans. A.E.S., Vol. 29 (1916), P. 183.

F. C. Mathers and A. McKinney—*Electrodeposition of Smooth, Solid Lead from Lead Nitrate Solutions;* Trans. A.E.S., Vol. 27 (1915), P. 131.

The Electrodeposition of Metals (Discussion); Trans. A.E.S., A.E.S., Vol. 23 (1913), P. 261.

E. B. Spear—*The Function of Inorganic Addition Agents in the Electrolytic Deposition of Copper;* Trans. A.E.S., Vol. 22 (1912), P. 281.

C. Y. Wen and E. F. Kern—*The Effect of Organic and Inorganic Addition Agents Upon the Electro-Deposition of Copper from Electrolytes Containing Arsenic;* Trans. A.E.S., Vol. 20 (1911), P. 121.

E. F. Kern—*Addition Agents in Electrolytes;* Trans. A.E.S., Vol. 15 (1909), P. 441.

C. Hering—*Visible Migration of Particles Between Electrodes;* Trans. A.E.S., Vol. 10 (1906), P. 35.

A. Smee—*Elements of Electro-Metallurgy;* First American Edition (1852).

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Blackening Aluminum Alloys

Question: Can you give us a formula for a solution that will blacken aluminum alloys. We do not have equipment for anodizing, therefore would prefer a simple method, if possible.

S. W. R.

Answer: The following baths will produce a black color on most aluminum alloys:

1)	Ammonium molybdate	10-20 gms.
	Sodium acetate	5-20 "
	Ammonium chloride	5 "
	Water	1 gallon
2)	Potassium permanganate	5-10 gms.
	Nitric acid	2-4 ml.
	Copper Nitrate	20-25 gms.
	Water	1 liter.

Excessive Water in Vapor Degreaser

Question: We seem to accumulate an excessive amount of water in our vapor degreaser. All the parts going into the machine are very dry, except for the slight amount of mineral oil with which they are coated in our shop production. Can you tell us where this water could be coming from?

S. D. S.

Answer: The most common cause of this type of degreaser trouble is from too low a temperature of the water circulating through the cooling coils at the top of the degreaser. This water needs to be only cool enough to condense the trichlorethylene vapors. If it falls below the dew point of the air in the room (100-120°F.) it will cause condensation of water vapor from the atmosphere, which then runs down into the degreaser. Check the temperature of the condenser water at its outlet to determine if this is the cause of your trouble.

Hydrogen Embrittlement of Steel Springs

Question: We recently had the problem of stripping cadmium plate and replating some large (¾" stock x 2½' long) steel springs. We used our regular electrocleaner first, then stripped off the old cadmium in our hydrochloric acid tank, which we felt would also remove the rust at the same time. While in the acid tank several of these springs broke apart suddenly. We know this must be due to hydrogen, and for future guidance we would appreciate knowing what treatments can be used for this work to avoid this trouble.

S. H. C.

Answer: You are correct in ascribing the trouble to hydrogen absorption. This could occur either in the cathodic cleaning step or in the acid pickle. To avoid this, other methods of degreasing and surface cleaning should be used. The first step should be a degreasing operation in some type of solvent or in a vapor degreaser. This can be followed by a very short anodic clean (not over 1 minute). The rust can be removed by one of several methods: blasting with sand, blasting with liquid abrasives, or tumbling in a barrel. These operations will also remove most of the cadmium plating, but if further stripping of the plating is necessary it can be done in a solution of ammonium nitrate (1 lb./gal.). After this the parts are lightly etched by a short anodic treatment in dilute sulfuric acid solution (500 gm./l. room temp., 1 minute, 150 a.s.f.) to promote good adhesion of the subsequent plate, then rinsed twice in water, once in weak sodium cyanide solution, then plated in the regular cadmium bath. After plating, the parts should be baked for about two hours at 350-375°F. It is essential that no flexing of the springs take place between the plating and baking steps.

Drag Marks in Buffing Copper Plate

Question: At times we run into trouble when buffing our copper plated parts, in that a large number of drag marks show up. We cannot seem to buff these smooth, and usually have to strip and replate them. This does not happen on all the parts, only a few in each batch. Can you suggest where we should look for the trouble, and how it can be remedied?

L. C. P.

Answer: Drag marks can be caused by several things. In this case it is probably due to pitted plating or hard particles in the copper bath which become attached to the plated parts. Pitting can be overcome by adding a small quantity of anti-pit agent. The names of several suppliers of good anti-pit materials for copper plating are being sent to you. Hard particles in the copper bath usually come from the anodes, and can be eliminated by using anode bags or a diaphragm to separate the anode and cathode areas, in conjunction with continuous filtration. Use of moving cathode rods is also helpful in overcoming both pitting and rough particles. The introduction of a wire wheel operation prior to buffing may make it possible to use parts already plated somewhat rough, but the source of the trouble should be eliminated as above.

Building Up Worn Threaded Parts

Question: We are faced with the problem of building up the size of the worn threads on large oil-field tools. We have tried chrome plating,

but the results have not been satisfactory due to the excessive build-up on only certain parts of the threads. Any suggestion you can make will be much appreciated.

R. C.

Answer: Heavy deposits of chrome on threaded parts are usually not satisfactory due to the inherent poor throwing power of chrome plating baths. Some improvement in this property has been made in a recently introduced chrome plating bath, and you might want to try this new method out first. The name of the firm that can help you in this matter is being forwarded. Another possibility would be to build up with hard nickel instead of chrome. While the final hardness of the deposit will not be as great, the greater throwing power of the nickel bath will make a uniform build up of the threads a possibility. It is doubtful if these parts could be plated right to size, regardless of the metal deposited. It is usually necessary to deposit a coating several thousandths of an inch heavier than is desired, then grind or machine back to size. In this respect, the nickel coating will be easier to machine, as hard chrome can only be sized by grinding, whereas even hard nickel can be machined in a lathe with the proper tools. Another suggestion would be to deposit the bulk of the build-up from a nickel bath, machine back to size, then deposit a thin coating of chrome for extra wear resistance.

Direct Nickel Plating on Plastics

Question: We would like to plate nickel directly over a silvered plastic surface. Can this be done, and if so, can you give us the necessary details?

A. P.

Answer: There is no reason why nickel cannot be plated directly over the silvered surface. However, because the adhesion of the silver film to the plastic is usually not very good, it is essential that the nickel deposit be free of stresses, as otherwise the nickel plate will tend to curl up and pull away from the part. Soft, ductile nickel deposits should therefore be used. It is also necessary that the nickel bath be able to wet the silvered surface quickly, and as organic wetting agents added to the nickel bath may increase the brittleness of the plate, it would be better to keep the silvered surface of the part wet at all times after the silvering operation, and to nickel plate as soon as possible.

Gold Plating Barrel

Question: We have been trying to locate some information on a gold plating barrel known as the Weiserman barrel. Can you tell us where such information can be obtained?

L. A. J.

Answer: This is a new one on us. After a number of inquiries we have been unable to locate any information. Perhaps some of our readers may have information on this barrel and will pass it along to us so we can enlighten L. A. J.

Anodizing Aluminum with Alternating Current

Question: We have been trying to locate information on the use of alternating current in the anodizing of aluminum alloys. We know that some work has been done in this field, and would appreciate any help you can give us in locating references to this work.

T. F. F.

Answer: Quite a bit of investigation has been made in the field of alternating current anodizing, using either A.C. alone or using the A.C. superimposed on the D.C. current. A patent (U. S. 2111377) was granted to *Wales* for a process of anodizing in sulfuric acid with A.C. alone. A much harder coating was claimed, and the process was developed for coating pistons of 12% silicon alloy. Another patent (U. S. 1735286) covered the use of A.C. in an oxalic or malonic acid type bath. Accurate control of coating thickness was the chief claim. A third patent (U. S. 1735509) for superimposed A.C. on D.C. in an oxalic acid bath claimed that pitting and local attack could be overcome. There are undoubtedly other important contributions in this field, but these will serve as an introduction and will lead to other references.

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PATENTS

Reversible Polarity Generator

U. S. Patent 2,490,629. *H. S. Jacobs and W. J. Cherones, assignors to Harnischfeger Corp.*

The combination with a direct current generator of a forward field winding mounted in a field frame; a reverse field winding separate from said forward field winding mounted in said field frame; an independent source of excitation current for said forward and reverse field windings including an independent forward excitation means adapted to be adjusted to provide a current path joining said independent excitation current source with said forward field winding for establishing a field current therein of such polarity as to cause a forward output of pre-determined polarity to appear at said generator terminals, and an independent reverse excitation means adapted to be adjusted to provide a current path joining said independent excitation current source with said reverse field winding when said independent forward excitation means are inactive for establishing a field current in said reverse field winding of such polarity as to cause a reverse output of predetermined polarity opposite to that of said forward output to appear at said generator terminals.

Heat-Diffused Plated Alloy Coatings

U. S. Patent 2,490,700. *J. S. Nachtman.*

In a method of forming a smooth homogeneous alloy coating on ferrous metal base stock, the steps of electroplating at least three layers of at least two alloying metals on the base stock, one of which metals has a melting point above the annealing temperature of the base stock and the other of which metals has a melting temperature below the annealing temperature of the base stock, and in such proportions that the higher melting point metal is in excess and is interposed between the lower melting point metal and the base stock, then heat treating the thus plated metals to start diffusion of the same by subjecting the plated strip under non-oxidizing conditions at an initial temperature below the melting point of the lowest melting point metal and then gradually increasing the heat treating temperature to a higher point above the melting point of the lowest melting point coating metal to the point of complete diffusion between the metal layers and to a temperature sufficient to anneal the base stock but maintaining the temperature below the melting point of the alloy formed.

Electroplating on Chromium or Chromium-Iron Alloys

U. S. Patent 2,491,126. *E. F. G. McGill, assignor to Electric & Musical Industries, Ltd.*

A method of electroplating on a basis metal consisting essentially of chromium and iron, said method comprising cleaning and then drying said basis metal, dipping said basis metal in a bath of a fused salt from the class consisting of sodium bisulphate and potassium bisulphate, whereby said basis metal is provided with a thin film of said salt to protect the basis metal from oxidation, withdrawing the filmed metal from said bath, allowing the filmed metal to cool, and then electroplating upon said basis metal in a bath of a metal from the class consisting of nickel and copper, whereby the bisulphate is dissolved and is replaced by a coating of said last mentioned metal.

Safety Guard for Buffing Machines

U. S. Patent 2,491,269. *J. M. Kelly, assignor to Gerity-Michigan Corp.*

A buffiing wheel guard in combination with a hood and pneumatic dust removing system, comprising a guard supporting means secured within the hood rearwardly of the buffing wheel, a guard located within said hood and supported by said means; a transverse rotatable drive shaft located within said hood and extending outside thereof; gearing between said shaft and said guard adapted to operate and move said guard to various positions of adjustment; a gear fixed to said transverse shaft and located outside said hood; a cooperating gearing and shaft mounted on the outside of the hood for turning said transverse shaft, said shaft extending to the top of the hood; and a means connected with the upper end of said shaft whereby the operator may operate the mechanism to adjust said guard in said hood.

Safety Device for Hot Dip Tinning

U. S. Patent 2,491,316. *H. C. Kirk, assignor to National Steel Corp.*

In hot dip tinplating apparatus, the combination comprising, means for successively hot dip plating a series of sheets, power-actuated feed rolls for propelling the plated sheets upwardly from the plating means along a path, power-actuated catcher rolls disposed above the feed rolls for advancing the sheets further along the path, opposed guide members, a pair of shafts supporting the guide members on opposite sides of the path of sheets between the feed rolls and the catcher rolls in a normal position in which the guide members are arranged to guide a normal sheet therebetween along the path to the catcher rolls, each shaft being rotatable about an axis extending parallel to the sheets and transversely of the direction of sheet travel and the shafts movably supporting the guide members for movement through an arc away from the path and each other to a different position upon receiving a deformed sheet from the feed rolls, means resiliently urging the guide members toward the normal position to support and guide the normal sheets and providing restrained movement of the guide members to said different position and control means mechanically engaging and operable by movement of the guide members all the way to said different position to stop the feed rolls whereby the feed rolls are stopped upon feeding a deformed sheet to the guide members.

Silver-Copper Oxide Rectifier

U. S. Patent 2,493,076. *M. Lazarus.*

As an article of manufacture an argentous rectifier for alternating currents comprising a base of copper, a rectifying layer of metallic silver and fused cuprous oxide, the silver particles being unevenly distributed in the layer, the portion of the layer which is nearest to the copper base having therein a larger proportion of silver particles and the portion of the layer which is further away from the copper base having therein a lesser proportion of silver particles, and a contacting terminal on the face of the rectifying layer which is remote from the copper base.

Cleaning and Activating Metals for Phosphate Coatings

U. S. Patent 2,490,062. *G. W. Jernstedt, assignor to Westinghouse Electric Corp.*

The process of simultaneously cleaning and activating the surfaces of metals selected from the group consisting of ferrous, zinc, cadmium and aluminum metals to enable an improved subsequent formation of protective phosphate coatings thereon comprising applying to the metal surface an aqueous solution consisting of a composition derived by dissolving in water 0.005% to 20% by weight of a water soluble compound of at least one of the group of metals consisting of titanium, zirconium, lead and tin and the balance being disodium orthophosphate and evaporating the solution to dryness, the residue so derived being dissolved in water to provide a concentration of from 0.1% to 2% by weight of the disodium orthophosphate, an alkaline cleaning composition suitable for cleaning the metal surface to provide a pH of from 10 to 12.5 in the aqueous solution, and the balance being water, and then applying to the cleaned and activated metal surface a phosphate coating composition comprising a dilute aqueous solution containing a phosphate salt, phosphoric acid and an oxidizing agent.

Plating Conveyor

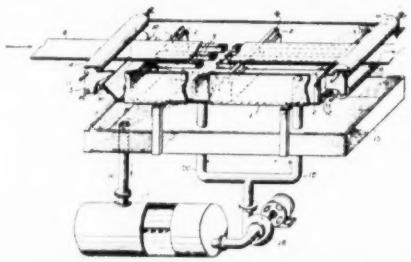
U. S. Patent 2,488,801. *R. J. Broersma, assignor to Paul E. Droppers and Melvin A. Porter*

In a structure of the class described, an endless chain conveyor having overlapping flat side links, rivets through the ends of adjacent links and spacers around the rivets betwen the links, some of said links at one side of the conveyor chain at spaced distances in the length thereof each having an outwardly extending flange at right angles to the body of the link, said flange having an open ended slot from one edge thereof toward the other edge and between its outer free edge and the body of the link, and a wire spring member connected with the body of each of said links near one end thereof and below said flange, extending from its point of connection underneath the flange and therefrom curved in the arc of a circle upwardly and back substantially to the under side of said flange and extending partly across said slot, and terminating in a terminal section located at an angle to the plane of the body of the link and extending outwardly in the direction of the outer free edge of said flange.

Continuous Strip Plating Apparatus

U. S. Patent 2,490,055. *C. M. Hoff, assignor to National Steel Corp.*

A strip plating apparatus comprising a tank for holding a plating solution, having side, end, and bottom walls, means for passing a strip across the top of said tank in a plane substantially coincident with the plane of solution level, said last-mentioned means comprising a lower roll at the



exit end and located with its upper surface substantially tangential to the plane of the solution level, and a cathode contact roll above said roll, said rolls being adapted to receive the strip therebetween, the end wall of said tank at the exit end extending upward almost to the plane of the solution level and being positioned so that the rolls are beyond the said end wall in the direction of motion of said strip, an anode located in said tank below the solution level, electrode connections for the said anode and for said contact roll, extensions on the side walls of the tank and a sealing means extending from the said exit end wall to said lower roll which together with the extensions on the side walls of the tank form a container for holding the plating solution and for restraining its flow from the tank.

Coated Abrasive

U. S. Patent 2,490,231. *N. P. Robie and A. L. Ball, assignors to The Carborundum Co.*

A flexible abrasive sheet for use under conditions developing high abrading surface temperatures comprising a base, a layer of abrading particles spread over the base, an adhesive coat softenable by heat anchoring the abrading particles to the base, and a substantially continuous thin protective film consisting essentially of inorganic material of the alkali metal silicates group united to the adhesive coat, surrounding said particles in general conformity with the surface contours thereof, and forming a seal against exposure of the adhesive coat, said film being of relatively stable consistency and remaining dry and non-sticky at high abrading surface temperatures, thereby materially avoiding the accumulation of dust arising from the abrasion operation on and between the abrading particles irrespective of the softening of said adhesive coat at said high abrading surface temperatures.

Method of Controlling Flow Brightening of Plated Metal Articles

U. S. Patent 2,490,084. *H. P. Munger, assignor to Republic Steel Corp.*

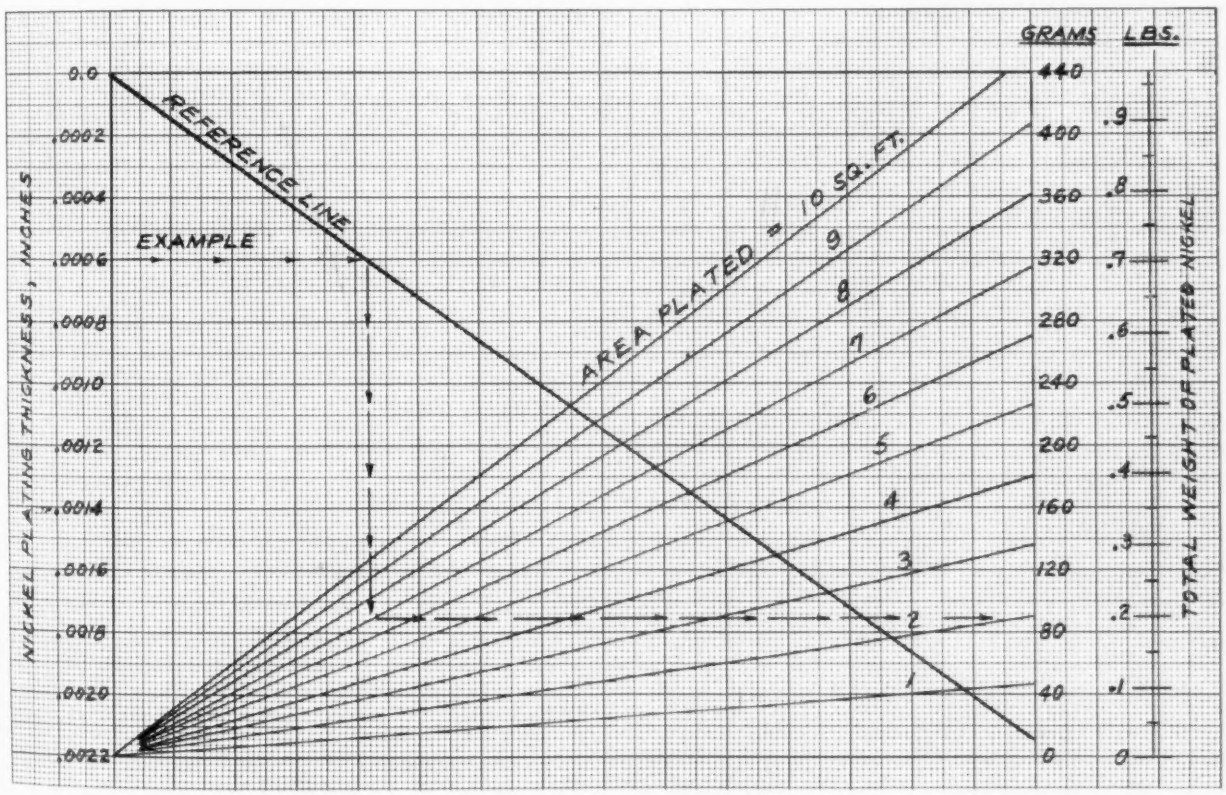
Apparatus for controllably heat-treating an elongated member which is continuously moving in the direction of its length in a fluid medium, said elongated member comprising a base-member of a relatively high-melting-point metal having a thin plating of a relatively low-melting point metal, said apparatus comprising the combination, with the means for moving said elongated member, of inductive heating-means adapted to subject a portion of said elongated member to a high-frequency field, while said elongated member is moving in said fluid medium, whereby the field-alteration introduce a large amount of heat sufficient to heat the elongated member to heat-treatment temperatures which is slightly above the melting point of the plated metal, said inductive heating means including a heating coil having a plurality of spaced convolutions, means disposed outside of said coil for directing a beam of light through a space between convolutions and against the elongated member at a predetermined place within the confines of the region where the temperature of the elongated member is being increased, and spaced from but near the end of said region, and a reflected light-responsive scanning-means disposed outside of said coil for so controlling the relation between the rate of heat-input in the heating portion and the speed of the elongated member as to keep the flow-line of the just melted plating substantially at said predetermined place, said scanning-means being adapted to be responsive to the difference in the reflectivity of the plating before and after melting.

Engineering Information Useful In
Designating Metallic Surface Treatments

Engineering Data Sheet

Calculating Metal Cost in Nickel Plating

With the aid of the chart below it is a simple matter to calculate the metal cost for depositing a given thickness of nickel on a known surface area. The example shown by the dotted line illustrates the calculation for a deposit of .0006" of nickel on a surface of 7 sq. feet. The chart below is for the usual decorative deposits. For heavier deposits the appropriate multiplication can be made. The weight of nickel is multiplied by the per lb. price of nickel anodes to get the total metal cost.



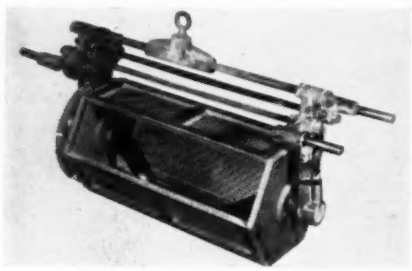
Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Ribless Barrel Plating Cylinder

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

This firm announces the development of a Mercil-type ribless cylinder, in 14" x 30" size for use with all commonly employed plating solutions. This cylinder is said to hold 15% more work than the same overall size of any conventional plating cylinder. The ribless cylinder is in hexagon shape, and has no ribs, no tie-rods, and no tie-



rod tubing. Merlon sheet stock is utilized for the five covers, with a dovetailed slot milled along the edge of each cover. The joining is made by a dovetailed piece of Merlon driven into each slot. The heads and ends of the covers are milled with a ¼" groove, and in assembling a ¼" x ½" Merlon key is fitted into the slot of the cover and also the head. The heads are joined to the ends of the covers with two flat head screws in each cover.

This cylinder employs flexible dangler, hair pin dangler or disc type contacts. Where flexible dangler contacts are used, the heads are furnished with Merlon bushings, and Merlon trunions are used in the hangers. With hair pin dangler or disc contacts, steel trunions with standard flanged type covers are supplied. Ribless Merlon cylinders are claimed to have been in successful operation for a considerable length of time in the plant of a large screw manufacturing company. Maintenance costs are said to be greatly reduced because of this simplified construction. Also, where the flexible dangler contact is used there is no chance of build-up of deposit on parts of the cylinder, as the only place in the cylinder where current is available is at the end of the flexible dangler contact.

Overcoming Corrosion of Electrical Wiring in Metal Finishing Plants

The United States Stoneware Co., Dept. MF, 60 East 42nd St., New York 17, N. Y.

Every metal finishing plant, almost without exception, has been faced with the problem of corrosion of the electrical wire and cables in their plating and pickling rooms. The trouble is endless, necessitating periodic replacements and expense.

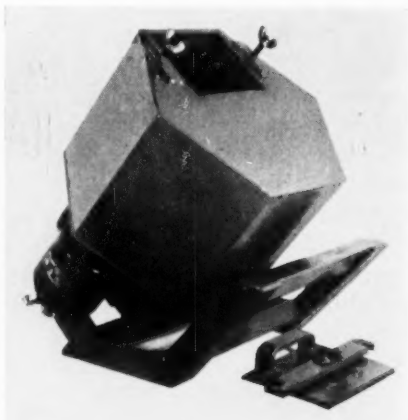
The solution is easy, according to this firm. Where the wiring is encased in Tygon flexible tubing this corrosion problem is solved for all time. Tygon tubing, besides being fully resistant to the action of all the corrosive fumes and solutions as used in metal finishing plants, is also non-oxidizing, non-hardening and non-aging, it is claimed.

A copy of Tygon Tubing Bulletin D-78 will gladly be sent to any plant that asks for it.

Portable Bench-Type Tumbling Barrel

American Plating Rack Co., Dept. MF, 232 N. Rosemary, Inkster, Mich.

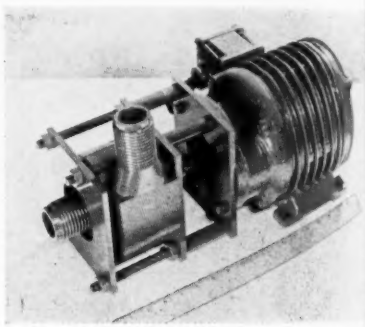
This firm has recently announced a new tumbling barrel of small size that can be placed on a bench for processing small lots of parts by



tumbling. It is equipped with an air-cooled motor and speed reducer, and is said to be able to handle up to 75 lbs. of load. Speeds may be adjusted by changing pulleys. The base of the machine allows stability in both the loading and running positions. Complete details furnished on request.

Pump for Corrosive Fluids

Nukem Products Corp., Dept. MF, Buffalo 20, N. Y.



This firm announces the development of a corrosion resistant pump for circulating plating solutions, pickling baths, and other solutions where there is a need for a completely impervious material. Available in sizes from 10-300 gals./min., these pumps are claimed to need no stuffing boxes and will handle all solutions with the exception of conc. nitric acid or strong chromic acid solutions, or sulfuric acid in excess of 75% strength. Pump and motor combination, or the pump alone, are available. The motor is a totally enclosed, ½ H.P., 1,75[illegible] r.p.m. unit. Further details may be obtained by writing to the firm at the above address.

Corrosion Resistant Coating for Tanks, Ducts

Specialty Coatings Laboratory, Dept. MF, 1721 N. Water St., Milwaukee 2, Wisc.

This firm has developed a series of plastic-base coatings to solve specific corrosion proofing problems.

The first of the new coatings, known

as the V-200 series, are recommended for use wherever a simplified coating system is required to protect chemical or processing equipment from strong corrosive fumes.

The V-200 coatings are available in clear or colors and may be applied by spray, dip, or brush to be quickly air dried or baked and yield a flexible, abrasion resistant coating highly adherent even to polished metal surfaces, according to the firm. The coating has a coverage of approximately 250 sq. ft. per gallon per mil thickness.

The corrosion inhibitive pigments compounded into the chemically inert resin system are claimed to produce long-time protection when subjected to corrosive salt atmospheres, alcohols, soaps, fruit juices, acids, alkali, petroleum products, or related corrosives.

Plastic-Lined Drums

Schori Process Div., Dept. MF, Ferro-Co. Corp., 8-11 Forty-Third Rd., Long Island City 1, N. Y.

This firm now offers polyethylene-lined 30-and 50-gal. Hackney open-head seamless drums lined with polyethylene 1/32" thick; 1/8" linings are also available upon request, for use where the linings are subject to mechanical abuse.

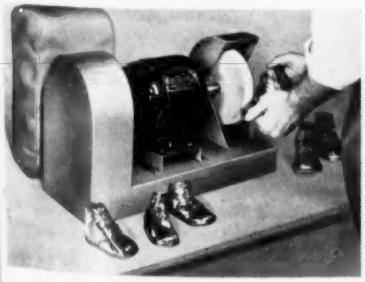
Polyethylene-lined drums eliminate the high damage potential of crocks and glass vessels. The 1/32" lined drums are priced lower than comparable rubber-lined drums, it is claimed, and since the coatings are permanent the drums are returnable and may be used over and over.

Schori Process Div. specializes in lining tanks and other equipment with polyethylene by the Flame Spray process.

Buffer and Polisher

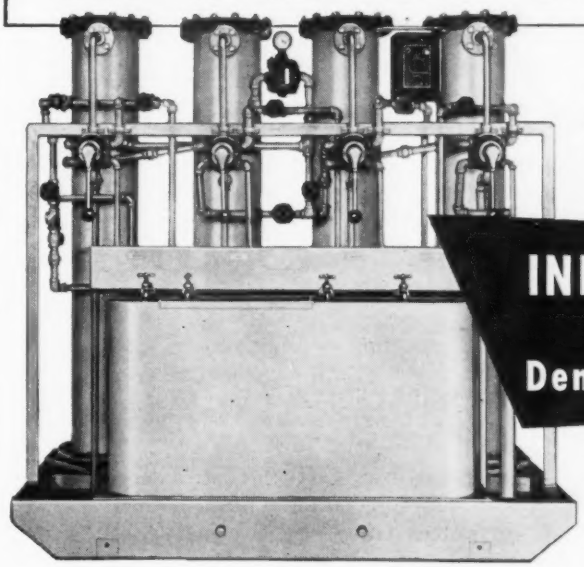
Warner Electric Co., Inc., Dept. MF, 1512 West Jarvis Ave., Chicago 26, Ill.

This firm announces a new bench-size buffing and polishing unit design-



Eliminate Hot-Rinse Stains Unwanted Precipitates

USE CHEMICALLY PURE WATER



only a few cents a thousand gallons *with* . . . .

INDUSTRIAL Water Demineralizers

A four-bed Industrial Water Demineralizer. Standard two- and four-bed units available with capacities of 200 to 1000 gph. Special units of any capacity —engineered to requirements.

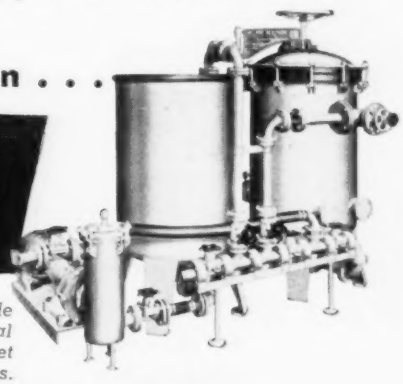
and it's as simple as it looks . . .

besides the extremely low cost, there is nothing complicated about getting the chemically pure water with Industrial Demineralizers. Raw water is passed through either two or four beds of ion-exchange resins and it comes out free of the dissolved mineral salts. No still, heat, steam, or cooling water is needed—keeping space requirements relatively small.

And it's simple to get the complete facts for your case. Send us a water analysis and let us know how much water you have to treat and the gallons per hour needed. We can then give you the whole demineralizer story including estimated costs, equipment required, performance data, etc. for your requirements.

for solution clarification . . .

use an INDUSTRIAL Filter



100 to 15,000 gallons per hour. Portable and stationary models. Standard or special filtration systems engineered to meet unusual requirements.

Write for full information and recommendations

FILTERS Pressure Type • PUMPS Centrifugal • CORROSION TESTING APPARATUS Salt Fog • Humidity

INDUSTRIAL FILTER & PUMP MFG. CO.

1627 West Carroll Avenue
Chicago 12, Illinois

RUBBER DIVISION Vulcanized Linings • Molded Products

WATER DEMINERALIZERS

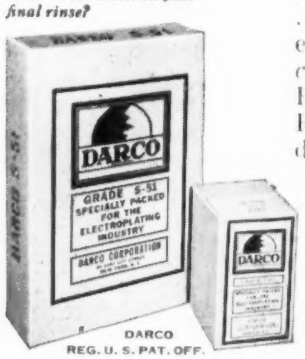
Start Clean... Stay Clean!

Clean shoes for the party . . . a clean bath for the plating!

Don't smear the works at any time — especially when it comes to putting clean work into a plating bath of questionable purity and running the risk of wasting the time, labor, and expense that goes into cleaning work for plating.

Start clean . . . *stay* clean — use Darco S-51 to *keep* impurities out of your plating bath. Darco adsorbs impurities to its surfaces before they can be deposited on the freshly cleaned surface of your work.

Is your plating bath as clean as the water in your final rinse?



Darco Red Label S-51 is especially easy to handle . . . to wet . . . to incorporate into a slurry. It's especially treated for use in plating — *the only carbon that will meet the benzol-mercury test!* Place an order for Red Label Darco S-51 today. Practically all leading suppliers carry Darco — do not accept substitutes!

DARCO CORPORATION

60 East 42nd Street, New York 17, N. Y.

cd especially for electroplaters, jewelers, service and repair shops, laboratory and machine shops.

One of its features is the built-in Vacumatic dust collector system that eliminates nuisance dusts when using scratch brush, abrasive wheels or cloth or felt buffs. High velocity, mill-wheel type exhaust fan instantly removes wheel ravelings, grit and dust from work area and disposes of them in the Air-Filter collecting bag; no external exhaust is required, it is claimed.

The complete unit is a compact: 20" long by 8½" deep by 11½" high. Buffing shield designed to accomodate any type wheel up to 8 inches in diameter. Requires only a minimum of maintenance . . . Mill-wheel type fan blades are self-cleaning, air-filter dust collection bag is quickly removable for emptying.

Measuring Chromic Acid Mist in the Atmosphere

Mine Safety Appliances Co., Dept. MF, Braddock, Thomas and Meade St., Pittsburgh 8, Penn.

Accurate, on-the-spot analyses of atmospheric concentrations of chromic acid mist in chromium plating establishments are now possible with the new, portable M-S-A Samplair. The Samplair is also valuable in checking poor ventilation, defective piping and faulty processing systems, it is claimed. It is hand-operated, and can be used where power is unobtainable, or where electrically powered drives would constitute a fire or explosion hazard.

Basically a specially-constructed hand-pump, the Samplair is so simple to use that almost anyone with a minimum of instruction can make rapid and reliable estimates. The Samplair draws 600 ml. per stroke of the pump handle, and determinations are made by comparing the specially treated filter paper discs used for the tests with established color standards. The filters will indicate concentrations from 0.5 mg./10 cu.m. to 4.0 mgs./10 cu.m.

Additional information on the new M-S-A Samplair is presented in illustrated bulletin No. CT-8.

Plating Barrel Clamp

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

A new and improved barrel clamp

of Merlon construction called Type "C" has been announced by the above firm.

The advantages of the new clamp include the following:

1. It is constructed of two parts compared with six in the clamp formerly available.

2. The clamp is simpler to operate, being provided with an adjustable screw to take up contraction or expansion.

3. The new clamp has no metal parts, thus eliminating possible places where a metal deposit might build up.

4. The clamp will be of molded construction for all 14" cylinders. For other sizes, the clamps will be cut to order.

5. The cost of the new Type "C" clamp is lower than the old type.

Water-Displacing Rust Preventative

London Chemical Co., Dept. MF, 607 S. Dearborn St., Chicago 5, Ill.

A new water-displacing type of rust preventive known as Sealbrite is being introduced to the metal cleaning, fab-

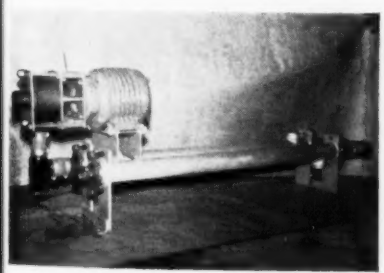
ricating and processing industries by this company.

Sealbrite is claimed to have passed 30-day condensation tests under alternating conditions of high and low temperature and humidity, using polished steel blocks, as well as the standard 30-day humidity cabinet and 30-hour salt spray tests.

The coverage of Sealbrite is between 2,700 and 3,200 square feet per gallon, according to the firm. It is applied by a cold dip or spray operation. After dipping, the water on the metal pieces is pushed out from all surfaces no matter how deeply creviced or irregular, and is displaced by a perfectly dry protective film, it is claimed. The water removed from the surface of the metal drops to the bottom of the tank and can be drained off periodically without affecting the efficiency of the solution. The Sealbrite film, which has a dry, waxy feel, is easily removed with ordinary petroleum naphthas. Its fingerprint neutralizing properties are said to eliminate the need for reprocessing and prevent rusting under the film.

Heat Exchangers for Plating Baths

Carl Buck & Associates, Dept. MF, P.O. Box 267, Essex Falls, N. J.



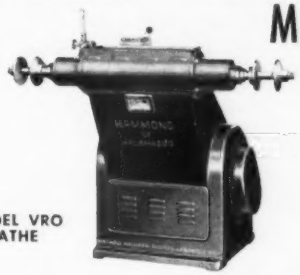
Designed for the metal cleaning and finishing industry, the Camac Karbate unit exchanger utilizes the acid resistance of non-metallic materials. Exchanger tubes are Karbate, which has proven to be immune to attack from all pickling and plating solutions except those containing nitric and chromic acids. The heat transfer qualities of Karbate are said to be excellent, which makes possible a light and compact unit, which can be used either for heating or cooling plating baths.

The high heat transfer characteristic of the Karbate tube is utilized by circulating the acid solution through the tubes at a high velocity. This is accomplished by using a Nu-Kast #166 pump which was designed primarily for this service. Pump characteristics are large flow, approximately 80 g.p.m., at a low head, which combined with efficient design requires only ½ H.P. The pump is constructed of Nu-Kast which is claimed to be immune to all pickling and plating acids except nitric and chromic acids. Simplified design makes the pump accessible and easy to service. Seal is mechanical and operates without the leakage and frequent adjustment necessary with the usual acid pump, it is claimed.

Fittings and connections are simple. Acid connections are all made with neoprene hose and stainless worm drive clamps. These connections give flexibility and simplicity in dismantling for cleaning and service when necessary. Long curved hose runs are eliminated by the use of Camac elbows and tees which have the same acid immunity as the rest of the unit.

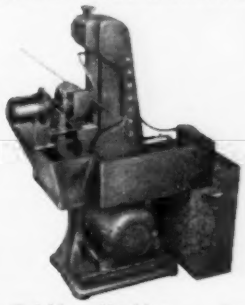
Camac Karbate unit exchangers are supplied with all internal connections made up and the complete unit run in and tested. Further details and specifications available on writing to the above address.

Hammond
of KALAMAZOO
A COMPLETE LINE OF
GRINDING, POLISHING AND AUTOMATIC FINISHING MACHINERY



MODEL VRO LATHE

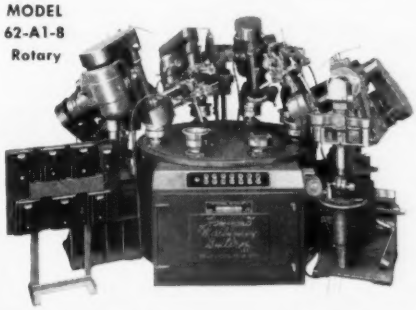
Variable Speed Polishing Lathes — Single and two spindle Lathes — 1500 to 3000 RPM. Also made in single speed models. Also furnished with Backstands for abrasive belt polishing.



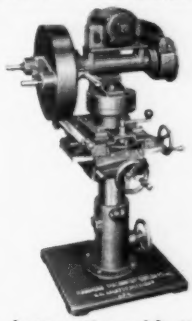
MODEL OD-1

Cylindrical Finishing Machines — For tubes, bars and cylindrical shapes: Model OD-1 up to 2¾" diameter polishing or buffing. Model OD-9 with polishing wheel or belt, for ¼" to 9" diameter.

MODEL 62-A1-8 Rotary



Strait-Line and Rotary Automatic Finishing Machines — For fast production finishing, polishing, buffing, deburring and brushing — Model 62-A1-8 Rotary shown. Write for catalog on Rotary and Strait-Line Automatics.



MODEL E2PF

Junior Automatics — 10 Models to choose from, according to work requirements. With one, two or four spindles — simple rotating spindle or stroke movement—for use in conjunction with polishing Lathes.

Hammond Machinery Builders INC.
1601 DOUGLAS AVENUE • KALAMAZOO, MICHIGAN

In the modern NUTONE plant

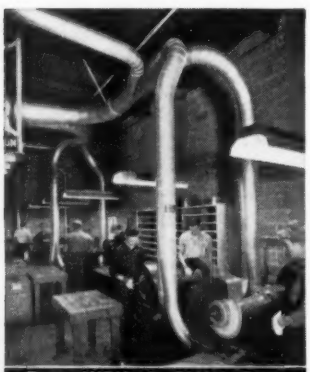
...6 DIFFERENT INSTALLATIONS By KIRK AND BLUM!

- 2 DUST CONTROL SYSTEMS
- DEGREASING AND ACID ETCHING VENTILATION
- PAINT SPRAY BOOTHS (INSTALLED ONLY)
- PAINT DRYING OVEN AND CONVEYOR
- MAKE-UP AIR SUPPLY SYSTEM

A variety of problems in the Finishing Departments of NuTone Incorporated, were solved by KIRK & BLUM Engineers. Shown here are the various installations which were designed, fabricated and installed by KIRK & BLUM.

Of special importance is the "Make-up" Air Supply System which filters, heats and replaces air exhausted by the other systems, eliminating undesirable winter drafts.

The wide experience of the KIRK & BLUM organization is at your service. "Clean Air . . . the Invisible Tool" can do much to increase the efficiency of your operations. For more details and literature, write The Kirk & Blum Mfg. Co., 2859 Spring Grove Ave., Cincinnati 25, Ohio.

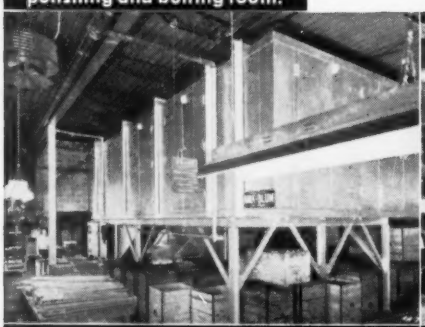


Two KIRK & BLUM Dust Control Systems serve the polishing and buffing room.

FOR CLEAN AIR . . . THE [redacted] TOOL

KIRK AND BLUM

DUST AND FUME CONTROL SYSTEMS
INDUSTRIAL OVENS



Overhead conveyorized Paint Drying Oven installed complete by KIRK & BLUM.

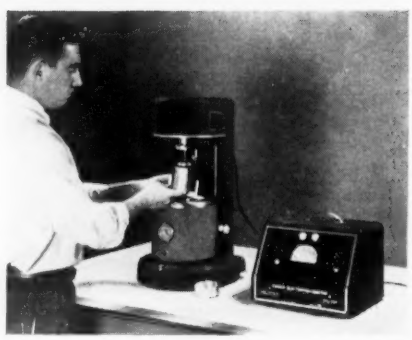
"Make-up" air supply system replaces air exhausted from plant.

Direct Viscosity Measurement

Fisher Scientific Co., Dept. MF, 717 Forbes St., Pittsburg 19, Pa.

Viscosity measurements directly in centipoise units and without the need for calculations are now provided for the first time by use of the new Fisher Electroviscometer. The instrument provides highly reproducible results, has unusual sensitivity over its full range, and is simple to operate, it is claimed.

The new instrument comprises a stand on which the sample is held in a sample cup and revolved at constant speed around a "bobbin". This central element is movable and can be turned in opposition to the natural pull of the liquid under study as shearing



force is exerted against the bobbin. A magnetic field, to which variable amounts of electrical force can be applied, is created around the bobbin, adjustive by control knobs on the separate power supply and meter unit. When the magnetic force applied to the bobbin exactly counter-balances the mechanical force exerted by the rotating liquid, the viscosity is expressed in centipoise units read directly from the scale of the instrument.

Features include the choice of two sizes of bobbins, one for liquids of low viscosity (0-500 centipoises), and one for heavier liquids of 500 to 5,000 centipoises. The stand incorporates a constant temperature bath which is readily placed and removed; also a ventilating fan to cool the magnetic coil above the bobbin. The 110 volt A.C. power supply is regulated to insure constant speed of the sample cup rotation and force applied to the bobbin.

Magnet Picks Up Metal Parts from Floors

Eriez Mfg. Co., Dept. MF, Erie, Pa.

A low-cost permanent magnetic device for sweeping up or retrieving ferrous material from floors, parking lots, dock areas, driveways, etc., is now being marketed by the above firm.

This lightweight rotary magnet operates just like a carpet sweeper, with the magnetic tube mounted between Neoprene wheels. Ferrous material jumps to the magnet and spreads itself over the entire circumference to a thickness of about ¾", it is claimed. Unloading is accomplished at either end by simply pushing the wiper ring from one end of the tube to the other, where a non-magnetic section causes the load to be released. Available in sizes ranging from approximately 12 to 36 inches.

Activated Carbon

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

The above firm is now offering to the electroplating industry a new activated carbon called Pur-O-Carb. This material is suitable for purifying bright nickel solutions of all types.

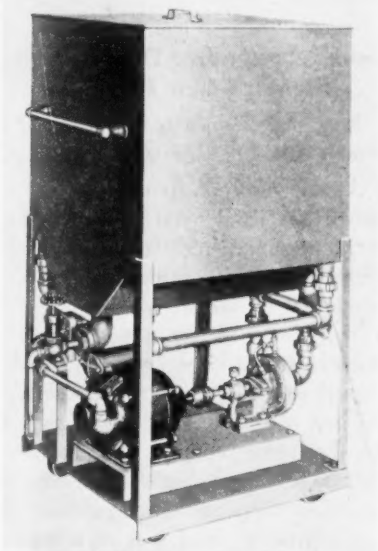
including the H-VW-M 9H solutions, and also for all other acid and alkaline plating solutions, it is claimed.

Every production batch of Pur-O-Carb is tested in the H-VW-M laboratory for effectiveness. Upon approval, a label is placed on each container which goes into warehouses or direct to the consumer. This assures the user that he will receive a high quality uniform carbon, approved for use in electroplating.

Spray-Washer for Intricate Assemblies

Industrial Filter & Pump Manufacturing Co., Dept. MF, 1621 W. Carroll Ave., Chicago 12, Ill.

This unit was developed for washing intricate assemblies like typewriters, teletype machines, etc. It is a great time-saver for concerns who do their own maintenance and periodic cleaning. A thorough cleaning is accomplished in a very short time without disassembling these machines. In manufacturing, baskets of small parts can be handled as units.



The unit is substantially built, consisting essentially of a welded steel tank, 24"x24"x24", with a perforated steel false bottom for supporting the work to be cleaned. In each corner are four swivel spray nozzles that direct fine, forceful sprays on the parts. An ample supply of the solvent is carried in the sump below the false bottom.

The tank is supported on a sturdy frame of angle-iron and steel base which carries the pumping unit for circulating the solvent. The motor and switch are of the explosion-proof type to permit the use of low-flash-point cleaning solvent. Four 3-inch casters provide for easy mobility. The unit is finished inside and out with a solvent-resistant paint. The over-all height is 49½ inches.

THE Balanced Solvent
BLACOSOLV
STABILIZED NOT ALKALIZED
ONE solvent, ONE price for all jobs
The new Blacosolv is the most stable solvent we've ever offered for metal degreasing. Aluminum, steel, copper and precious metals may be safely and scientifically degreased with the same solvent.
Blacosolv contains a mixture of entirely new and different stabilizers. They are not alkaline materials which neutralize acid after breakdown. They are new stabilizers that prevent solvent breakdown and possible acid formation. Contains no alkaline materials that can be mistaken for stability . . . no masking agents are added.
USE BLACOSOLV IN ALL SOLVENT-VAPOR DEGREASERS
G. S. BLAKESLEE & CO.
BLACOSOLV DEGREASERS AND SOLVENT
NIAGARA METAL PARTS WASHERS
G. S. BLAKESLEE CO., CHICAGO 50, ILLINOIS
NEW YORK, N. Y. TORONTO, ONT

Lowering the Cost of Chromic Acid Treatments

Mutual Chemical Co. of America, Dept. MF, 270 Madison Ave., N. Y. 16, N. Y.

Possible cost saving in chromic acid anodizing, as well as other metal treatments such as copper stripping, brass pickling, magnesium dips and chromium plating, are indicated through the use of oxidation-resistant cationic exchange resins. In a preliminary investigation by this firm, certain commercial resins have been found which are stable in the presence of chromic acid, and can be used for removing dissolved metals, with recovery of the chromic acid for re-use. An added advantage is in minimizing the potential problem of waste disposal. Complete details are available by writing to the above address.

Identification and Sorting of Metals and Plating

Electro-Chemical Instrument Laboratories, Dept. MF, 532 Woodland Ave., Mountainside, N. J.

Recently placed on the market by this firm is an instrument for sorting and identifying metals by an electrochemical method. The method is said to be very simple and to require only a few seconds per test. Various solutions are included with the set to

What Is "Low Cost"

The cost of plating racks: meaning the rack itself, its insulation, and necessary repairing is often an important factor in production plating costs. Low first cost in dollars is not always the lowest final cost. Good racks that can be kept in production work day after day mean savings in time and labor and increased output of good work.

If BUNATOL No. 1002 Paste insulation is used the production of racks is greatly increased, the time out for repairs is decreased, and the first cost of the insulation is actually no greater than other insulating materials.

BUNATOL No. 1002 Paste insulation is a new 100% solids plastisol. A single coat forms a thick and tough insulation that withstands all plating solutions and alkaline cleaners. The heavy thick coating reduces rack repairs. The insulation has an extra hard and glossy surface that rinses freely and does not drag out or carry over solutions from tank to tank. Racks insulated with No. 1002 can be used in the Copper-Nickel-Chrome cycle or in any other plating operation. When a rack does need repairing the insulation can be patched over the repair.

Paste insulation requires baking in an oven. If you have an oven this becomes a simple, time saving operation. If an oven is not available let us give you data and suggestions on how to build an oven for baking racks with an exceedingly small investment. The savings in the use of BUNATOL Paste insulation will soon pay for the equipment.

May we send complete information and samples on BUNATOL No. 1002 Paste insulation and show how this improved insulation can save you money. A request on your letterhead will bring this information without obligation.

NELSON J. QUINN COMPANY TOLEDO 7, OHIO

— for 15 years —

Rack Insulation Exclusively

identify a wide range of metals and commercial alloys, as well as electroplated deposits. In making a test, the sample is connected to the measuring instrument by means of the battery clip, then touched with the special probe containing the test solution. The meter reading is then referred to a calibrated chart for identification of the metal. Complete details are available by writing to the above firm.

Laboratory Filter

Ertel Engineering Corp., Dept. MF, 40 Front St., Kingston, N. Y.

This firm announces a new cylinder-type laboratory filter, precision constructed in either stainless steel, hard rubber or brass (nickel or silver plated). This all-purpose laboratory filter has a capacity of 1.3 liters; its filtering surface is 9.62 square inches; filter disk diameter is 4⅛ inches.

One of the features of this unit is its ability to accommodate any type filter medium. The construction permits easy refill without dissembling. Model 10 is 27" high overall. Simple thumb screw adjustment permits raising or lowering the filter to accommodate various height vessels.

To allow full view of the product during the filtering process a 45 ounce capacity glass cylinder is furnished. The filter is equipped with a pressure gauge for 0-60 p.s.i.

Asbestos filter sheets having the accepted Ertel standard of low calcium and iron content are available for Model 10 if desired.

Acid Resistant Floor Coating

Stonhard Co., Dept. MF, 500 Stonhard Bldg., 1306 Spring Garden St., Phila. 23, Pa.

After extensive laboratory and field tests, the Stonhard Co. introduces Stonhard Stoncote, an acid-resistant coating for floors, walls, machinery, etc. Stoncote is not an ordinary paint; it is a special plastic formula that has been proved under the most severe conditions encountered in any industrial plant, according to this firm.

It can easily be applied to all maintenance areas or wherever corrosion is a special problem—on concerte floors, walls, ceilings, structural steel, tanks, pipes, vats, ducts, machinery and equipment. It may be applied with either a brush or a spray, and it will dry in from one-half to one hour under ordinary temperatures. It is available in five colors, as well as in black, white, transparent, and aluminum.

Ion Exchange Bed Displays Visible Signal When Exhausted

Resinous Products Div., Rohm & Haas Co., Dept. MF, Philadelphia, Pa.

A new concept in deionization, the use of a special dyed mixture of Amberlite resins which change color as the bed becomes exhausted, has been developed by the above firm.

The Monobed technique itself, which delivers water extremely free of ionic impurities by a single passage through the bed of exchangers, was announced by the same company's laboratories only a few weeks ago. The Monobed provides complete deionization, yielding a product with a mineral content of less than one part per million from ordinary faucet water, it is claimed. Addition of the new indicating feature affords a simple means of checking qualitatively the exhaustion point of the bed.

Dyed a dark blue in its regenerated state, the Monobed becomes a yellowish brown when exhausted. The user, operating such a bed in a transparent tube or vessel, can watch the latter color travel slowly down the bed as exhaustion advances. Thus, without instrumentation of any kind, he has accurate knowledge and ample warning of the time when he should regenerate or replace the resins. Capacity of the bed to absorb ionized salts is not exhausted until the brown line reaches the bottom of the bed.

This visual means of determining the end-point depends in operation on the combined performance of an anion exchanger and a cation exchanger. Together, they prevent leakage from the bed and result in a sharp, rather than a gradual separation of colors.

Uses of the new concept are expected to include small-quantity applications where water of extreme freedom from ionic impurities is required at low cost and with a minimum of equipment.

Corrosion-Resistant Flexible Resin Coating

Carboline Co., Dept. MF, 7603 Forsythe Blvd., St. Louis 5, Mo.

Developed as a ready-to-apply, flexible, corrosion-resistant coating, this new resin is claimed to have the following advantages over the polyvinyl chloride and chlorinated rubber type materials:

1—Resistance to acids of higher concentrations.

2—Resistance to higher temperatures (180-200°F).

3—Resistance to alcohols and straight-chain chlorinated and aromatic hydrocarbons.

Because there is no plasticizer required in this material to obtain flexibility, there is said to be no loss of flexibility due to the plasticizer leaching out or migrating in corrosive service. Samples for experimental tests are available by writing to the firm at the above address.

Spiral Nozzle for Wide Angle Spray

Bete Fog Nozzle Co., Dept. MF, Greenfield, Mass.

Unusually wide angle sprays can now be obtained by means of a newly designed spiral nozzle, according to an announcement by the above firm.

The new nozzle is the latest addition to a line of nozzles using a unique patented spiral principle, first put on the market last year by the Bete Company.

In addition to the wide angle of spray, the new nozzle was designed for low flow rates and requires extremely low pressures, according to the manufacturer. It will produce fine and uniform drop sizes with a 180 degree umbrella spray pattern of wide coverage, it is claimed.

The nozzle, due to its spiral design, is relatively non-clogging and can be easily cleaned on the job by means of removable pin. The pin itself is interchangeable to provide for different flow rates.

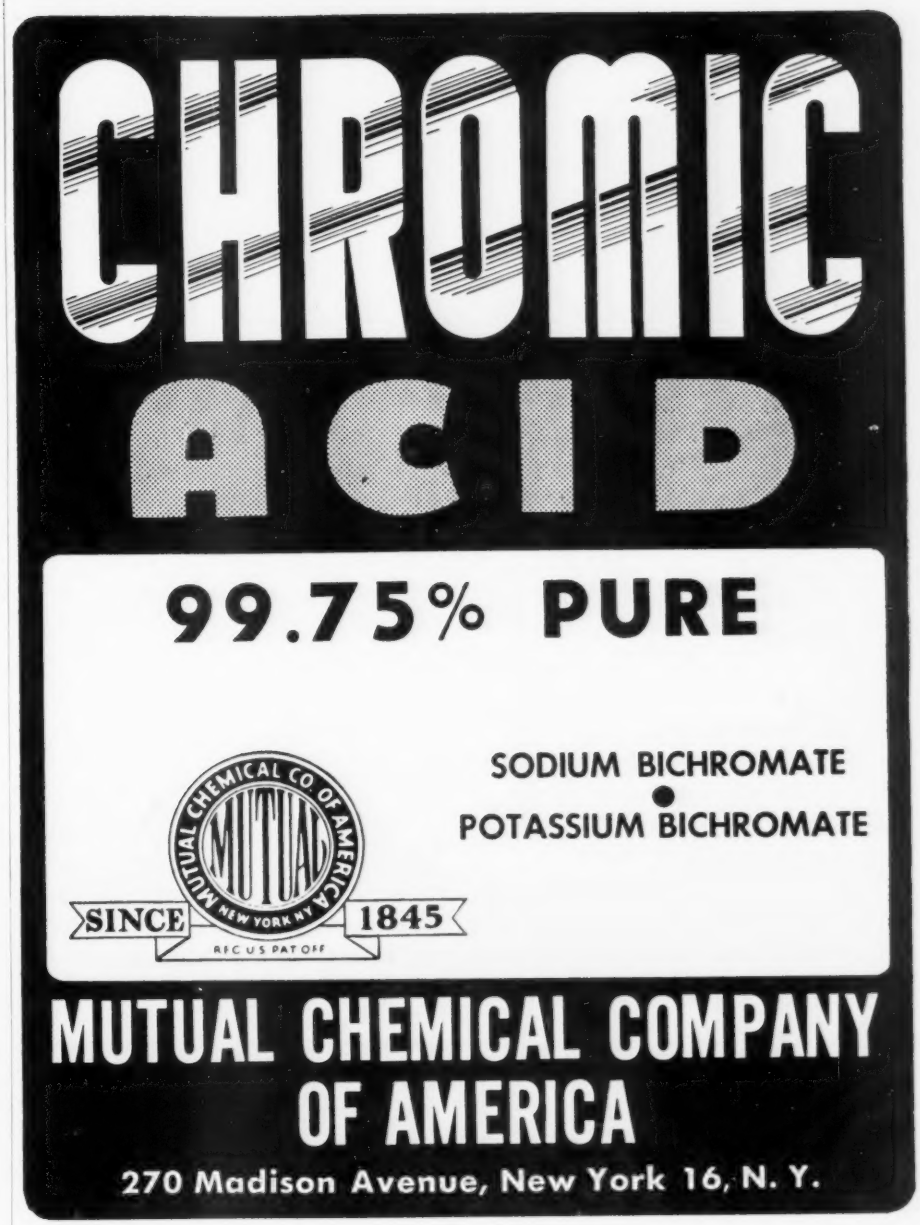
The new nozzle is now available in two sizes, for ½ to 2 g.p.m. and for 1½ to 4 g.p.m. capacities.

Gas Flowmeter

Fischer & Porter Co., Dept. MF, County Line Rd., Hatboro, Pa.

A new variable-area gas flowmeter known as the Floguide has been developed by the above firm. The tapered precision-bore metering tube and the "float" are fabricated from stainless steel. The metering tube is brazed to the cast iron inlet and outlet fittings, permitting simple and attractive panel installations. The extension below the metering tube carries an accurate metering scale, and an indicator below the float permits direct reading of flow rate. The wide-angle scale can be read from within a 180° arc and is also rotatable for complete flexibility of installation.

The Floguide is available in capacities ranging from 45 to 16,000 standard cubic feet of carbon dioxide per hour, and comparable capacities for other gases. Although primarily designed for low pressure service, Floguide meters can be furnished to withstand 600 p.s.i.g. working pressure in all sizes. Maximum operating temperature is limited by the properties of commercially-available packings.



"I'm sold on DU-LITE!

. . . and here's why. When you are running a large volume of steel parts in your black oxidizing bath, you cannot afford to have any stoppages or slow-downs because of inefficient operation. After installing DU-LITE, our black finishing trouble was over. Now the process is fast and sure and, what is more, the process is inexpensive to install and simple to operate. The Du-Lite Chemical Corporation also has factory trained engineers to get you started and find the workable answers to every finishing problem that arises."

While matching or excelling, in every respect, any other process for the chemical blacking of steel, except stainless, DU-LITE remains less costly to operate than most, so why not DO IT RIGHT WITH DU-LITE. *Write, or phone today.*

THE DU-LITE CHEMICAL CORPORATION

110 RIVER ROAD • MIDDLETOWN • CONN.

Business Items

Minnesota Mining Elects New Director

Louis F. Weyand, of Detroit, vice president in charge of the *Minnesota Mining & Manufacturing Co.'s* adhesives and coatings division, was elected to the firm's board of directors recently.

A veteran of 35 years with the company, Weyand joined 3M in 1915. He subsequently held a number of sales supervisory posts, and was named general manager of the adhesives division in 1945. He was elected a vice president of the firm in 1948.

Hauser Joins Bart-Messing

Mr. Morris Messing, President of *Bart-Messing Corp.*, announces the addition of *Mr. Eugene B. Hauser* to their sales organization as Equipment Sales Engineer. Mr. Hauser will cover the New Jersey State Territory and handle speciality accounts in various other territories.

For over ten years previous to his joining the Bart-Messing Corp., Mr. Hauser was associated with Hanson-Van Winkle-Munning Co., as Design Engineer as well as Sales Engineer and Manager of the New York City District office.

Mr. Hauser comes well qualified for his new duties, having graduated from

Eugene B. Hauser

Stevens Institute of Technology as a Mechanical Engineer and having specialized in organic chemistry.

During World War II Mr. Hauser served his country as an Officer in the United States Naval Reserve. At the present time he holds the rank of Lieutenant Commander and is active in the Naval Reserve Volunteer as a Naval Ordinance Engineering Specialist.

Mr. Hauser is a member of the American Electroplaters Society, The American Legion, Stevens Metropolitan Club, Third Naval District Commissioned Officers' Club and the New Jersey Society of Professional Engineers.

Electric Products Co. Appoints Cincinnati Agents

The Electric Products Co., Cleveland, O., has appointed *Sheldon Storer and Associates* as district representatives for the south-western section of Ohio and the State of Kentucky.

With offices in Cincinnati Sheldon Storer and Associates will be responsible for promoting The Electric Products Co. line of synchronous and induction motors, A-C and D-C motors and generators, battery chargers, electrolytic power supplies, and frequency changers.

Special Electroplating Training Plans Available to Industry

The Joseph B. Kushner Electroplating School, licensed by the Penna. Department of Public Instruction as a correspondence institution for train-

ing in modern electroplating practice, announces that there is now available to industrial organizations a special *Electroplating Know How* tuition plan which permits members of the organization to enroll at a 20% reduction in the regular tuition fee, when 3 or more members are enrolled at the same time. Also available to plating and metal finishing departments is a special group incentive plan in which the Company and the individual trainee share the cost of the E. K. H. tuition and the individual's share is refunded by the Company on the basis of course ratings. Those interested can write for further details to *Joseph B. Kushner*, Director, *Joseph B. Kushner Electroplating School, Stroudsburg, 230, Pa.*

Manhattan Rubber Moves N. Y. Office

After April 15, the New York Offices of The *Manhattan Rubber Div.* of *Raybestos-Manhattan, Inc.* will be located at 500 Fifth Avenue, New York City, corner 42nd Street, where it will be able to serve its customers better. The previous location was at the Equitable Building at 120 Broadway for over 25 years.

These offices include the New York and New England district office of the Manhattan Rubber Division and the Corporation Export Department including Allied Asbestos and Rubber Co. (Export) Inc.

Castle New V.P. of Roto-Finish

Mr. Donald T. Barrett, President and Treasurer, *Roto-Finish Company*, of Kalamazoo, Mich., announced that the Board of Directors at their annual meeting elected *Mr. C. Heamon Castle* to the position of Vice-President.

C. Heamon Castle

The Roto-Finish Co., formerly known as The Sturgis Products Co., moved into their newly constructed plant at 3600 Milham Road in Kalamazoo during the summer of 1949.

The officers of the Company are: *D. T. Barrett*, Pres. and Treas.; *C. H. Castle*, V-Pres. and Tech. Dir.; and *J. W. Servaas*, V-Pres. and Sec.

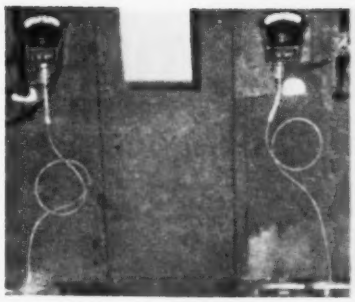
Fred Brune Joins Motor Products Corp.

Fred G. Brune, formerly with the Electric Auto-Lite Co. Lamp Division for many years as Chemical Supervisor and plating superintendent, has left that firm and is now with the *Marion Industries Division* of *Motor Products Corp.*, in Marion, Ohio.

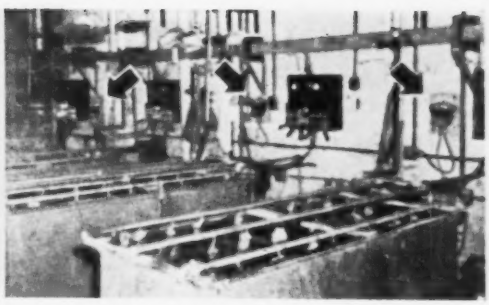
Miller Purchases The Filter Paper Co.

The Filter Paper Company, Chicago, Ill., manufacturers of filtering materials and liquids handling equipment, announces that *Mr. Charles Miller*, general manager and co-owner of the Company, has become sole owner, having purchased the full interest of his partner in February of this year.

For more than eighteen years, The Filter Paper Co. has been serving the metal finishing industry in the United



HIGH SPEED COPPER



NICKEL COPPER AND CHROME

YOU SET IT— SARCO *holds it!*

That seems to be the universal testimonial for Sarco LSI Electric Controls among plating men. "You see each batch is different" they say. "First we experiment—up or down a degree or two—just by turning the thumb screw. When we get it just right we tell the gang to leave it alone until the next batch comes along."

During the war, a battery of 22 high speed copper tanks illustrated at the left above, ran at 200°, 24 hours a day. "Temperatures cease to be a problem the day we put in Sarco Controls" they say. Today these tanks vary from 140° to 190°—depending on the work going through.

Imagine the advantages when you have nickel, copper and chrome all going at once. One inexpensive Sarco LSI on each tank does the job.

Perfect control affects all the elements in the cost of plating. Rejects, the biggest item, are practically eliminated. Less heat is used because no heat is wasted. The amount of metal deposited is the same all day long—no waste in materials.

This Sarco Control can also be furnished for alternate heating and cooling used in chrome plating. Temperature is indicated at all times on dial cut for maximum visibility in your range.

OTHER SARCO PLATING HELPS

DEGREASING CONTROLS • UNIT HEATER CONTROLS
HOT WATER TANK CONTROLS • STEAM TRAPS

265

SARCO SAVES STEAM
IMPROVES PRODUCT QUALITY AND OUTPUT

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

CHEMCLEAN BREVITIES

Facts Without Frills

FOR THE

SPRAY PAINTING DEPARTMENT

CHEMCOAT (NO. 800): Applied to the walls of spray booths to act as a barrier coating so that overspray can be readily removed. No sagging — no waiting.

Can be applied with brush, swab or by spraying.

Easily and quickly removed.

CHEMCLEAN NO. 8: Waterwash Compound — dispersing medium for all types of organic coatings in water wash spray booths.

Breaks up the coating particles, keeping them in an emulsified form.

Prevents clogging of pipes and nozzles.

CHEMPURGE (NO. 406): Alkaline stripper — used in wet spray booths as a purge to remove heavy accumulations of various types of organic coatings from pipes, nozzles and sides of tanks.

STRIPPERS FOR ANY AND EVERY ORGANIC COATING

AND — Don't forget — we manufacture:

BURNISH-ALL which burnishes all metals — ferrous — non-ferrous — precious

DI-PHASE CLEANER (Chemclean No. 133) which removes buffing compounds, hard, caked-on soils, oils, greases and drawing compounds.

Try them out — test them — find out for yourself how good they are with a TRIAL ORDER.

CHEMCLEAN PRODUCTS CORP.

Manufacturers of Industrial Cleaners, Strippers and Chemical Specialties

64 Avenue of the Americas

New York 13, N. Y.

States. All activities, products and services are not only being maintained but improved for better service than ever before. The company handles equipment and materials for the metal finishing industry including Plate and Frame Filter Presses, Water Filters, Stainless Steel Storage and Mixing Tanks, Portable Agitators, Pumps, Gravity, Conveyors, Filter Paper, Filter Cloths and Bags, and many other products.

The home office and plant is located at 2433 S. Michigan Avenue, Chicago 16, Ill.

Pennsalt Appoints LaCasse to Indiana Territory

Harold J. LaCasse has joined *Pennsylvania Salt Manufacturing Company's* Special Chemicals Department as field sales service representative in the Indiana territory, it was announced by *Joseph J. Duffy, Jr.*, sales manager of the department. Mr. LaCasse takes over the territory relinquished by John C. Hampson when he recently became sales manager of the department's newly-formed Chicago district.

Mr. LaCasse comes to Pennsalt from the Stewart Warner Corp. of Chicago, where he was a material specifications engineer. Previously he was associated with General Electric and Eastman Kodak in electroplating and metal-finishing operations. He was graduated from the University of Rochester as an industrial engineer. He is at present living in Indianapolis.

Bacon Felt Co. Celebrates Its 125th Anniversary

The first scene in the life of the *Bacon Felt Co.* took place in an old grist mill on the banks of the Aberjona River which flows through Winchester, Mass. One *Robert Bacon* of Boston, a hatter by trade, purchased this old mill with its undershot water wheel and converted it into a felt mill. For a few years he continued at his old trade making felt hats, but later added other felt products to his line such as wadding, saddle pads, slipper felts, and erasure felts. While the felt hat as known today is usually of rabbit fur, in those early days it was made of wool. The old Bacon Felt Co. survived three bad fires, to say nothing of the economic bad times to which the country has been subjected over the years. In 1850, operations still being carried on by the Bacon family were moved to the present location about a quarter of a mile away where the company continued to make a variety of felt products.

In 1876 came a revolutionary change in the company's objectives. *Charles N. Bacon*, grandson of the founder, perfected a method for making felt polishing wheels which he patented. Basically, it is the same method that is used today. Once the making of felt wheels, or "hard felts" as they were then called, was proved successful, the company discontinued consumer lines and concentrated production on felt wheels, sheet felt, and other industrial felts. Continuing on under the Bacon family direction and direct supervision, the company expanded its service to industry by broadening its line of wheels and other felt products. During World War I felts for gas masks were made for the government as well as polishing wheels for industry.

In 1932, after more than 100 years in the hands of the Bacon family, the company was sold to new interests consisting principally of the present owners, *Samuel S. McNeilly* and *Stanley N. McNeilly*, who are President and Vice President respectively. Samuel is in charge of manufacturing and wool purchases; Stanley is in charge of sales and sales promotion.

Shortly before World War II the

Samuel S. McNeilly

Stanley N. McNeilly

company brought out a line of bobs and small wheels for finishing small contoured parts. So it was only natural that during World War II, when the airplane became so all-important, the company was called upon to supply the airplane and parts industries with large quantities of small bobs and wheels of many shapes and sizes.

The McNeilly interests established a laboratory for testing wools, and devising better production methods and uses for wheels and bobs. Today, it is one of the best laboratories in the industry devoted to felts for polishing wheels, bobs and sheets, and other industrial uses. From this laboratory have come new products, such as mandrel-mounted bobs and the line of hair felts used in the glass manufacturing field.

Recently the company purchased a one-story 50,000 square foot factory in Taunton, Mass.,—a factory about twice the size of the present plant in Winchester. New processing machinery has been designed and when completed will be installed in the new factory. Plans call for a gradual shifting of production during the latter part of 1950 so that there will be little loss of time. By 1951, it is expected that the changeover will be completed and all production will be carried on in the Taunton factory. Present employment consists of approximately 50 men and women. It is expected that close to 100 employees will be needed in Taunton.

The brand name "Paramount" established in 1932 will be carried along to Taunton, and all felt products produced by Bacon Felt Co. will continue to carry that brand name.

Two Star Performers
FOR TROUBLE-FREE
SILVER PLATING
APW
"AA"
silver
anodes
silver
cyanide
APW "AA" Anodes insure better production, because of:
The large reduction in the amount of rejects of finished goods. Less stripping.
Full use of anode (no lace or herring bone formation). Less scrap.
Uniform dissolution of the anode, thereby maintaining a nearly constant anode area, facilitating computation of effective surface (of particular interest to larger plants).
Cleaner, brighter finished work . . . always.
Every anode lot is laboratory tested and guaranteed to give complete satisfaction under normal conditions.
APW Silver Cyanide meets all silver plating requirements. Its quality is consistently highly uniform and FREE FROM IMPURITIES. Due to its uniform particle size, APW Silver Cyanide dissolves faster.
Furnished in 100 or 1,000 ounce drums. We can ship any quantity promptly from stock.
WRITE US FOR FULL INFORMATION AND CURRENT QUOTATIONS.
THE AMERICAN PLATINUM WORKS
231 NEW JERSEY R.R. AVE., NEWARK 5, N. J.

General Ceramics Appoints Two New Representatives

Mr. C. R. Hocker has recently been appointed by the *General Ceramics and Steatite Corp.* as sales engineer and consultant on porcelain processing problems. Mr. Hocker, who has previously been associated with the Lapp Insulator organization as its New York representative for the past fourteen years, will cover General Ceramics' home office territory which is represented by the eastern coast as far west as middle Pennsylvania.

In the Texas and Gulf Coast area, General Ceramics has appointed *Mr. Thomas S. Whelan, Jr.*, of 1533 Althea Drive, Houston, Texas, as sales engineer to handle its complete line of process equipment. Mr. Whelan will cover all of Louisiana and the eastern part of Texas from San Antonio, east. A University of Oklahoma graduate in Chemical Engineering, Mr. Whelan was previously employed by the Humble Oil Company as a process engineer from 1938 to 1945. The following three years he served as assistant to the vice president in charge of exchanger rating and sales of Engineers and Fabricators, Inc., and in 1947, until his present change, he represented C. F. Braun as a sales engineer in their Texas and Gulf Coast territory.

Eaton New Research Director for E. F. Houghton

Dr. James T. Eaton has been named Director of Research of *E. F. Houghton & Co.*, Oil and Chemical Manufacturers, Philadelphia. Dr. Eaton, who was formerly titled Manager of Research, is in full charge of the company's Research & Control Department. He was also recently elected a

SPARKLER
horizontal plate
FILTERS

Good Plating Requires Clean Plating Solutions

Sparkler Horizontal Plate Filters effectively remove all solids and precipitates from plating solutions—provide positive assurance that solutions are free from undesirable matter.

The horizontal plate principle used by Sparkler makes possible the formation of firm, stable filter cakes that will not slip or crack under intermittent or continuous flow. Flow through the filter is always *with* gravity, and filter aid is floated into position, forming a firm cake of even thickness.

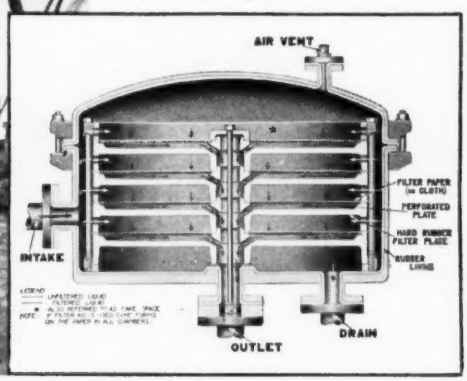
The accompanying photograph shows a typical Sparkler installation in a modern plating plant. Previously, in this plant, silver chloride slurry was shoveled into crocks and laboriously washed by decantation. Now, chloride is mechanically agitated, collected, and washed in the Sparkler filter. Cost of the operation has been sharply reduced and quality of the chloride has been greatly improved.

Filters are pressure-tight and leakproof, and are available in rubber-lined construction, stainless steel, or iron. Capacities from 60 to 10,000 G.P.H.

Our Engineering Service is available for your specific problems.

SPARKLER MANUFACTURING CO.
MUNDELEIN, ILLINOIS

This Sparkler Filter is used by a large silverware manufacturer in connection with the plating of silverware.



member of the company's Board of Directors.

Schaefer Brush Co. Offers Free Technical Service

Schaefer Brush Mfg. Co., 1032 So. Second St., Milwaukee, Wisc., one of the nation's largest manufacturers of industrial brushes, has instituted a new brush research and development division to help industry solve their cleaning problems.

The research division, if necessary, will send an engineer to the job for first-hand information on that particular cleaning problem. However, in most cases by merely sending the cleaning problem with proper information to Schaefer, its research division will be able to develop and recommend a brush suitable to solve the most difficult cleaning problem.

It is Schaefer's desire that all users of brushes will avail themselves of this service.

Haigler Joins Fischer & Porter

Mr. Edmund D. Haigler has recently joined the *Fisher & Porter Co.* in Hatboro, Penn., to work on special customer engineering problems.

Mr. Haigler, a graduate of Harvard Engineering & Business Schools, has over twenty years' experience in industrial instrumentation; with the Chevrolet Division of General Motors, the E. I. du Pont de Nemours & Co., Inc. (Ammonia, Cellophane, Rayon)

Edmund D. Haigler

and the Foxboro Company. He was Manager of Foxboro's Engineering Department for several years.

A member of the A.S.M.E., A.I.M.E. and N.S.P.E., Mr. Haigler was on the four-man instrument team which studied German industry for the U. S. Government in 1945. He has contributed to technical journals and engineering handbooks.

MacDonald New Houghton President—Other Officers Named

William F. MacDonald was elected president of *E. F. Houghton & Co.*, manufacturers of industrial oils, leathers and chemicals, at the annual stockholders' meeting held at the company's main offices at 303 W. Lehigh Ave., Philadelphia.

Mr. MacDonald, who will temporarily continue to hold also his present office as Treasurer, succeeds *Major Aaron E. Carpenter*, who voluntarily relinquished the presidency and was elected Chairman of the Board of Directors. By-laws provide that Major Carpenter shall still remain the chief executive officer of the company. He has been president since 1934, during which period the company's peacetime sales have quadrupled.

Mr. MacDonald, who is 46, was graduated from Wharton School, University of Pennsylvania, in 1927 and entered the employ of E. F. Houghton & Co. that year as a cost clerk. He has since served as industrial engineer, credit manager and Treasurer (1942). He was also named assistant to the president in 1946.

One new director was elected by the stockholders—*Dr. James T. Eaton*,

Manager of Research, who has been with the company since 1937. Dr. Eaton was formerly a research chemist for National Aniline Division, Allied Chemical & Dye Corp. He received his Ph. D. degree from the University of Illinois in 1934. He has headed Houghton's Research Department since 1946. His chief interest has been in the development of new surface active agents.

Other directors re-elected by the stockholders were: *G. W. Pressell*, vice-president; *Dr. R. H. Patch*, vice-president — Operations; *D. J. Richards*, vice-president—Sales; *E. A. Carpenter*, secretary; *C. H. Butler; H. B. Fox; L. D. Holland.*

Officers re-elected by the Board included also *Charles P. Stocke*, Ass't. Secretary and *Miss Marie A. Healey*, Ass't. Treasurer.

E. G. Schroeder Appointed Sales Manager of Electric Products Co.

Mr. G. J. Berry, Vice-President in charge of Sales of *The Electric Products Co.* takes pleasure in announcing the appointment of *Mr. E. G. Schroeder* to the position of Sales Manager. In his new position, Mr. Schroeder will be responsible to Mr. Berry for all Headquarters and Field Direct Sales Activities.

Previously Field Sales Manager, and prior to that position, District Manager of their Detroit Office, Mr. Schroeder has a broad industrial sales background.

A graduate electrical engineer of Renssaeler Polytechnic Institute, Mr. Schroeder was associated with the New York Electric and Gas Corporation and The General Electric Company before joining The Electric Products Company in 1945.

E. G. Schroeder

CORROSION goes hungry in the plant protected by Tygon Paint. This remarkable coating, proven over a ten-year period, forms a "live" plastic film so tough that corrosion can't eat through. Its use cuts maintenance costs to the bone, adds extra life to any equipment subjected to corrosive fumes, condensates or spillage. Write today for your free copy of Bulletin 709.

Resists Acids, Alkalies, Oil, Water, Alcohols • Applied by Spray Gun or Brush • Air Dries Quickly • Non-toxic and Non-Flammable when dry • Will not oxidize, flake-off or chip.

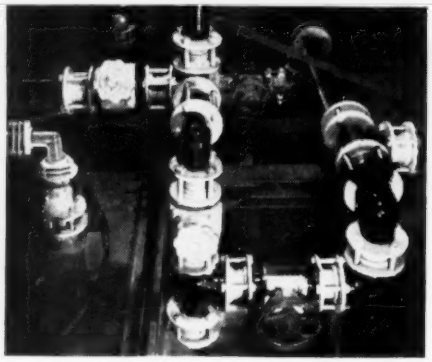
U. S. STONEWARE
Akron 9, Ohio

Imperial Rack Co. in New Quarters

Imperial Plating Rack Company, Inc., moved into enlarged quarters at *1613 Industrial Avenue, Flint, Mich. Mr. L. D. Faulman*, manager, reports 4,000 square feet of floor area available for the manufacturing of new plating racks, repairing old ones, and applying insulation to customers racks. This new plant provides quadruple the floor area of the former plant 800 Industrial Avenue. In the enlarged building racks as large as ten feet in length and two and one-half feet in width will be manufactured & insulated. With the added space & facilities, *Mr. William A. Zube*, sales manager, reports a ten to fourteen day delivery can be made on any quantity of racks or insulation.

Walterization Phosphating Process Looking for American Representation

The Walterization Company, Limited of Croydon, Surrey, England, manufacturers of the well-known and pat-



Now you can FORGET ABOUT Corrosion on . . .

PIPE, VALVES
FUME DUCTS
AGITATORS
BLOWERS
FITTINGS
TOWERS
PIPING
PUMPS
TANKS

Make your process equipment of HAVEG—and you can forget about corrosion! HAVEG is a different molded structural material that resists chemical action *through its entire mass.* Not just a lining or coating, its utility is not affected by surface gouges and abrasion. Moreover, HAVEG is strong. It resists shock. And it is remarkably easy to machine!

Standard items such as pipe, fittings, etc. can be shipped to you right from stock . . . specially designed and built tanks, and other "custom-built" equipment, will be delivered in just 4 weeks or less! So get your order in today—or write for the engineering bulletin F-5, today.

HAVEG CORPORATION
NEWARK 68, DELAWARE
FACTORY: MARSHALLTON, DEL. • TEL. WILMINGTON 3-8884

CHICAGO 11	CLEVELAND 14	HARTFORD	HOUSTON 6	DETROIT 11	LOS ANGELES 13	SEATTLE 1
1201 Palmolive Bldg.	550 Leader Bldg.	57 Farmington Ave.	4601 Montrose Blvd.	2832 E. Grand Blvd.	601 W. Fifth St.	Vance Bldg.
Delaware 7-6266	Cherry 7297	Hartford 64250	Jackson 2-6065	Madison 1575	Mutual 8955	Eliot 0890

ented phosphate rust proofing solutions, announce that their Canadian agents, *Messrs. British Machine Tools (Export) Ltd.*, of P.O. Box 113, Terminal Station "A", Toronto, will be showing the Walterization process at the Toronto Fair.

Mr. A. R. King, Sales Manager of Walterization, and one of the foremost experts on rust-proofing problems in Great Britain, will also attend the Fair and invites United States businessmen in the metal finishing industry to contact him with a view towards arranging suitable representation in the United States.

Mr. King will be staying at the Barbizon Plaza Hotel in New York City from May 17th to 24th, and between May 26th and June 14th he can be reached either at the Stand of British Machine Tools (Export) Ltd., at the Toronto Fair, or at the King Edward Hotel, Toronto.

Minnesota Mining Promotes Several Officers

The Minnesota Mining & Manufacturing Co. has promoted one officer and elected two new ones, it was announced recently. *Clarence M. King*, former assistant treasurer and assistant secretary, has been named treasurer. He will continue as assistant secretary. *George H. Schoettly* and *Edwin H. Church* are new assistant treasurers.

King joined the firm in 1926 as an accountant and was later appointed auditor. He became assistant treasurer in 1939 and was also elected assistant

C. M. King

secretary in 1948. King has been president and a director of the Minnesota Insurance Buyers Association.

Schoettly first served 3M as a bookkeeper for a year, then became assistant credit manager. He held that post for five years, and was credit manager for 20 years prior to his new promotion.

Church was controller of the Inland Rubber Corp. of Chicago before joining 3M in 1949, and was auditor of disbursements before assuming the post of assistant treasurer.

Course in Industrial Hygiene

The University of Michigan School of Public Health offers an Inservice Training Course in Industrial Hygiene for Safety Personnel, June 19, 20 and 21, 1950, at The School of Public Health Building, 109 South Observatory St., Ann Arbor, Mich.

Outline of Course Content

I. *Opening Session* — A panel emphasizing the problem of human relationships in plant safety practices.

II. *Sanitation*
   1. In-Plant Feeding Facilities
   2. Locker Rooms, Toilets, Wash Rooms and Sewage
   3. Cleansing Agents
      (a) Personal
      (b) Industrial
   4. Cleaning Equipment
      (a) Hand
      (b) Power
   5. Air Sanitation
   6. Cross Connections and Back Syphonage
   7. Drinking Fountains

III. *Plant Layout*
1. Heating and Ventilation
2. Process Ventilation and Maintenance
3. Lighting
4. Adjustment of Equipment to Proper Placement of Workers (Comfort and Fatigue as Accident and Health Factors)

IV. *Plant Skin Hazards*
1. Solvents
2. Degreasing
3. Dry Chemicals
4. Preventive Methods
5. Oils, Disinfectants and Other Additives
6. Identification and Evaluation of Existing and New Materials

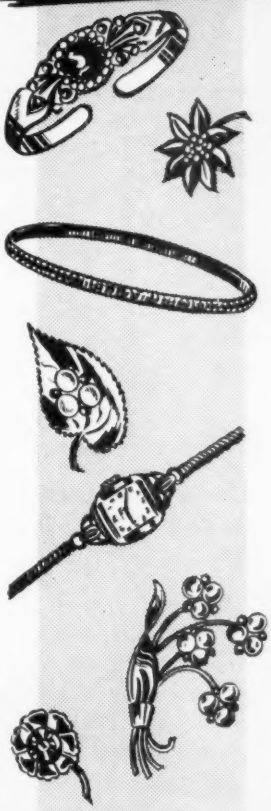
V. *Industrial Health Problems — Part I*
1. Plating
2. Pickling
3. Spraying
4. Sand Blasting
5. Heat Treating
   A. Salt Baths
   B. Atmospheric Furnaces
   C. Cyanide
      1. Storage
      2. Disposal
         (a) Chlorine Process
         (b) Electrolytic Process

VI. *Industrial Health Problems — Part II*
1. Poisonous Metals, Dusts, and Gases
   (a) Metals
      (1) Lead
      (2) Metalizing
      (3) Beryllium
      (4) Cadmium
      (5) Zinc
      (6) Mercury
   (b) Dusts
   (c) Gases
      (1) Carbon Monoxide
      (2) Sulphur Dioxide
      (3) Hydrogen Sulphide
      (4) Ammonia
      (5) Aldehydes
      (6) Carbon Dioxide

The course is designed especially for the benefit of safety personnel. "Safety personnel" as used here includes anyone responsible for safety, which in the smaller plants might be the manager or owner himself. However, other persons interested in the subject matter that will be presented are welcome to attend. Applications for enrollment in the course should be submitted in writing by letter addressed to *H. E. Miller, School of Public Health.* The enrollment fee is $5.00. Persons enrolling and completing the course will receive an official "Record of Attendance."

There are a limited number of rooms (most of them doubles) available at the Michigan Union. Persons wishing rooming accommodations should make application as early as possible direct to the University of Michigan Union. In making application be sure to state that the accommodation is requested in connection with attendance of this course.

If You're Paying for Hand Brushing to Remove Buffing Compound...



Study the Case of the Novelty Jewelry Manufacturer

A maker of novelty jewelry used rouge and a very insoluble type of lime compound to buff thousands of copper, brass, zinc, steel and gold-filled stainless steel parts every day. The parts that came out of his still cleaning tank all required a lot of hand brushing with soap solution to get them ready for plating.

No cleaner changed this situation until he tried Magnus 78NF. Now a brief immersion in a solution made up of 1 part 78NF to 3 parts water at 110° F. turns out parts that require no hand work at all on 90% of his production.

This safe, dependable emulsion-solvent cleaner has not only cut his labor cost to the bone, but has saved him considerable in cleaning material costs as well.

Magnus 78NF can also be used straight at room temperature followed by a cold water pressure rinse.

Magnus 78NF is one of many specialized Magnus Metal Cleaning Compounds that can save plenty in labor, time and material costs. Ask us for recommendations on your cleaning jobs.

MAGNUS CHEMICAL CO. • 11 South Ave., Garwood, N. J.
In Canada — Magnus Chemicals, Ltd., 4040 Rue Masson, Montreal 36, Que. Service representatives in principal cities.

Magnus
CLEANERS • EQUIPMENT • METHODS

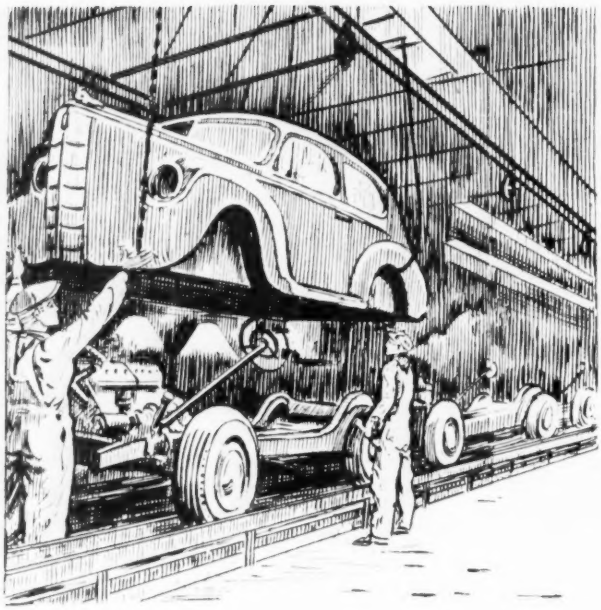
Pesco Named Optimus Distributor

The *Optimus Equipment Company* is pleased to announce the appointment of *Pesco Plating Equipment Corporation* of 132 Grand Street, New York City, New York, as our exclusive distributors of "Optimus" Vapor Degreasers, Metal Parts Washers, Dryers, "Optimus" Trichlorethylene, and "Optimus" Perchlorethylene.

New General Offices for Metal & Thermit Corporation

After 35 years at 120 Broadway, in downtown New York, *Metal & Thermit Corporation* is moving its general offices to the midtown area. The company's address, as of May first, will be 100 East 42nd Street, New York 17, N. Y.

Among the firm's products is a high-speed plating bath, based on potassium stannate, for low-cost tin plating.



MOTOR CITY PLATING NEWS

by

Edward Finne

Job plating in the Detroit area has been affected considerably by the Chrysler strike. Platers supplying finishes to sub-contractors of Chrysler and those plating directly for Chrysler have suffered as high as a 40% loss of business. And the outlook may be dim for the same platers in a few months because of the CIO's drive for additional benefits from General Motors. If GM goes out on strike, the same situation should prevail among job platers.

****

The Detroit office of the *Behr-Manning Corp.* held a "Contour Polishing Clinic" at their plant of 13140 Foley Ave., Monday through Saturday, March 20-25. The show was the first attempt of this sort in Detroit and was conducted by *Fritz Beiermeister* and *Lee Belanger*, district managers of the company.

Admittance was by invitation and the guests were invited to bring their own sample parts and try the Behr-Manning grinding and polishing equipment themselves. Demonstrations were given of the latest grinding and polishing methods employing coated abrasive belts and soft contact wheels on intricate articles. Also demonstrated was a Murray-Way sheet polishing machine using belts for finishing.

Approximately 300 interested persons representing 108 firms attended the clinic throughout the week.

****

The *Gerity-Michigan Corp.*, of Adrian, Mich., has reopened a plant that has been closed for 3 months in order to meet the demands for chrome plated stampings.

****

The Contract Plating Co., 480 Gleason Ave., Richmond, Mich., has opened under the new ownership of *Stanley Pawlak*. The recently purchased company has a 6,900 square foot capacity for production plating.

****

Ten years ago, *Joe* and *Fred Wagner* started selling plating supplies from one half of a $12.50 a month office. They disbursed supplies from a $5.00 a month rented warehouse.

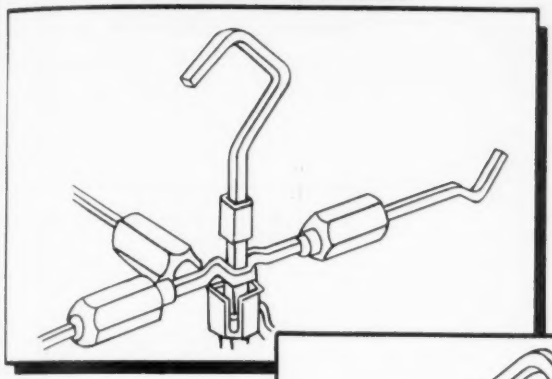
On March 30 and 31 of this year, they celebrated their 10th anniversary of the founding of *Wagner Brothers* with a party of their plant and office building at 400 Midland, Detroit. Approximately 300 friends attended the 2-day celebration which featured lots of entertainment, good food and liquid refreshments.

Joe and Fred have steadily built up their business from its humble begin-

Joe and Fred Wagner cutting their Tenth Anniversary cake.

Announcing the new GRIP-TIP REPLACEABLE TIP PLATING RACKS

SPECORAK



ANOTHER "SPEC" DEVELOPMENT CUTS YOUR PLATING COSTS AS NEVER BEFORE!

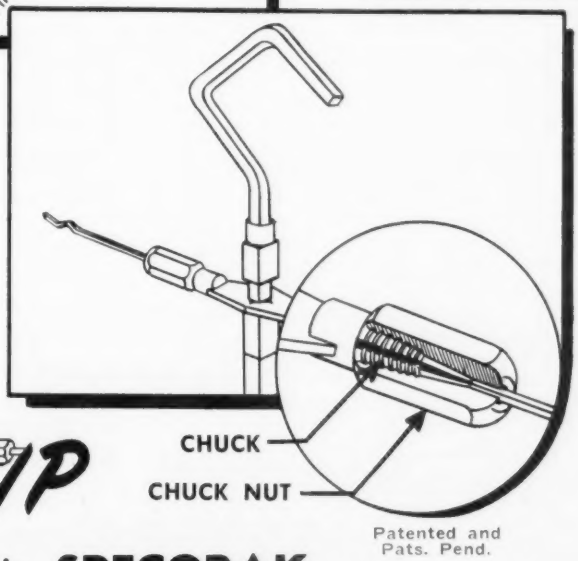
Here's Why:

- Work holders are made of square rods or wire which prevent rotation by angular eccentricity.
- Standard universal SPECORAK parts provide speedy assembly of efficient modern racks.
- Quick change-over to meet new production needs. Eliminate DEAD RACKS.

WIRE HOLDER ASSEMBLY

•

STAR ASSEMBLY
Permits any 45 degree angle assembly



GRIP-TIP

Patented and Pats. Pend.

Replaceable *Tip* **SPECORAK**

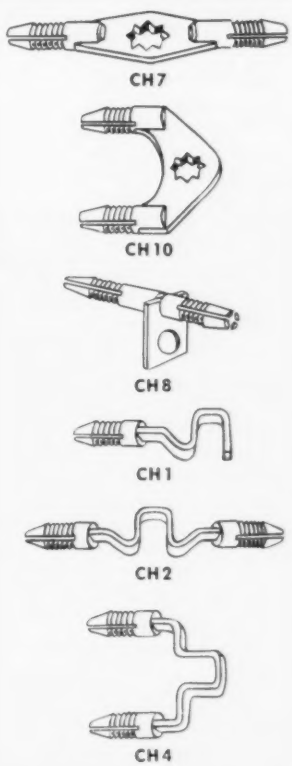
A BOON TO PLATERS!

Quick change of work holders are easily done with the new GRIP-TIP SPECORAK. It can be converted by simply removing the work holders right at the tip. Eliminates reassembly of the rack and saves recoating. GRIP-TIP work holders are made of square rods or wire which prevent rotation by angular eccentricity — grips immovably tight in chuck. All GRIP-TIP SPECORAK parts are mass produced at low cost. They're universal and interchangeable. Can be used over and over again for every type of plating job.

A supply of GRIP-TIP SPECORAK parts enable you to build racks of custom design and quality at amazing LOW COST. More important, you eliminate a worthless investment in idle racks.

We supply standard parts or assemble and coat racks to your specifications.

Only a few of many
GRIP-TIP SPECORAK
Standard Interchangeable Parts



Spines, Chores, Spacers, Work Holders etc., for building Single and Multiple racks are available from stock.

Write for Complete Catalog of Parts and Prices

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30 IRVING PLACE, NEW YORK 3, N. Y.

HERE'S YOUR GUARANTEE
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HANDY & HARMAN 999 "PLUS" FINE SILVER ANODES

When you see that triangle and "999+FINE" mark on a silver anode you can be sure of three things about that anode—(1) it is free of every trace of impurities that can cause plating troubles—(2) it measures up to highest standards in fineness—(3) it has physical properties that are ideal for plating . . . And when you *use* those anodes you can be sure of smooth going, profitable production of top quality plating. Look for that mark next time you buy silver anodes.

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ning to its present very respectable position in the plating supply and manufacturing field. Their many friends hope that the Wagner brothers will celebrate many more anniversaries.

****

The Detroit Section of the *American Chemical Society* held its March meeting on the 21st at the Horace Rackham Building. A dinner preceded the regular meeting and featured *R. B. Dixon* of the Hoover Report Committee who spoke on *Recommendations of the Hoover Report*. The speaker of the regular meeting was *Dr. W. T. Hanson, Jr.*, of the Eastman Kodak Co. who lectured on *Dye-Forming Colored Couplers in Color Photography*.

Homer Sanderson, who is operating as a manufacturers agent handling lead anodes and rack coatings, had a bit of luck lately. He and his wife were in need of a house, so his wife bought a ticket for the Detroit Builders Show Model Home given away free each year, and she won it. The home cost $18,000 to build and is the last word in home building in the Detroit area. The Sandersons naturally accepted it and moved in.

****

The Detroit Section of the *Electrochemical Society* at its March meeting held at Wayne University on Friday, March 17, presented a corrosion symposium. The speakers of the evening were *C. F. Nixon*, Ternstedt Division of General Motors; *W. D. McMasters*, GM Research Laboratories and *Walter J. Piper*, The Detroit Edison Co.

Mr. Nixon talked mainly on the testing of plated coatings; i.e., salt spray testing, ferroxyl test and hot water porosity testing.

Mr. McMasters' talk dealt with the testing of painted coatings and he outlined tests used in the paint industry for corrosion resistance testing. Mr. Piper described an accelerated corrosion test under study by the Detroit Edison Co. In this test, specimens are subjected to alternate atomized sprays of N/100 Sodium Chloride, N/10 Sulfuric acid and to Ultra Violet light.

Manufacturers' Literature

Blackening Bath for Steel

Heatbath Corp., Dept. MF, Springfield 1, Mass.

A new bulletin just issued by this firm describes the advantages of their Pentrate blackening bath for steels. This bath features controlled oxidation, whereby separate additions of alkali and oxidation agent may be added to maintain optimum blackening conditions. Advantages claimed for this bath are maximum efficiency through separate additions, and lowest cost of the commercial blackening baths. Copies of the bulletin are available on request.

Booklet on Abrasive Belts

Minnesota Mining and Mfg. Co., Dept. MF, 900 Fauquier St., St. Paul 6, Minn.

A new "Step Up Production" booklet on the use of abrasive belts in industry is announced by the above firm. It is available on request.

The new booklet provides 36 pages of case-history examples and technical data on grinding and polishing with abrasive belts. It brings up to date the information in the first "Step Up Production" booklet, published by the 3M company in 1947.

Abrasive belt techniques are described and pictured for a variety of materials—carbon and stainless steel sheets, steel tubing and bars, plastics, ceramics, glass, wood, odd-shaped products, and castings of gray iron, manganese, bronze, and aluminum.

Also covered is the new "pre-finishing" technique, in which the usual process of steel-forming-and-then-pol-

ishing is reversed in order to achieve maximum production line speed.

In addition the booklet provides details on belt equipment, belts, and various contact wheels that support the belt at the point of contact with the work. New belts, contact wheels and equipment are included.

Abrasive Grains

Simonds Abrasive Co. Dept. MF, Philadelphia 37, Pa.

This firm has recently issued three new bulletins describing their line of abrasive grains for polishing, pressure blasting, and anti-slip applications. Data Sheet No. 1 gives recommendations for the use of Borolon polishing abrasives in 4 grades to cover all metal polishing operations, as well as instructions for the proper methods of applying to the wheels. Sheet No. 2 on Boroblast abrasives shows how best results are obtained for foundry use with this silica-free, hard abrasive. Sheet No. 3, on Sans-Slip, outlines its use for providing non-skid flooring.

Small-Lot Plating Barrels

Belke Manufacturing Co., Dept. MF, 947 N. Cicero Ave., Chicago 51, Ill.

Gives complete information on Belke Porto-Platers and other Small-Lot barrels for barrel plating small odd lots in still plating tanks. Information on Belke Oblique Platers is also included. Copy of Bulletin 1120 furnished promptly on request.

Metal-Cleaning Guide

Oakite Products, Inc., Dept. MF, 118 Thames St., New York 6, N. Y.

The above firm has announced the publication of an illustrated, 44-page booklet, which reviews metal cleaning in all its phases.

After considering briefly the wide variety of soils which result from fabricating operations such as heat-treating, forging, rolling, stamping, drawing, extruding, spinning, grinding, machining, buffing, etc., the booklet discusses specific materials, equipment and procedures for most effective removal of these soils. Clearly, concisely reported upon are the following operations: tank cleaning; machine cleaning; electrocleaning of steel; electrocleaning of brass and other non-ferrous metals; pickling; deoxidizing; bright dipping; pre-paint cleaning and surface preparation by machine, tank and manual methods; steam-detergent cleaning; barrel cleaning; burnishing. The booklet also offers helpful recommendations for improving the effectiveness of metal cleaning operations in hard-water areas; for anti-rust protection of parts in production and during storage; on coolants and lubricants for machining and grinding; on simplified paint-stripping methods; and on treating wash water in paint-spray booths.

Copies of this new booklet are available without charge.

Cutting Costs in the Pickle House

International Nickel Co., Dept. MF, 67 Wall St., New York 5, N. Y.

How costs can be cut in the pickling department of steel and other plants is described in detail in a new 8-page booklet just issued by this firm.

Illustrated throughout, it quotes some records of equipment used to pickle steel in all forms—from sheets and coiled strip to wire and tubing.

The new booklet lists five money-saving results that have been achieved in pickle houses throughout the country: longer equipment life, greater pay loads, greater versatility in equipment design, readily available equipment, and greater safety. The booklet is available without charge.

Airblasting Pressure Tanks

American Wheelabrator and Equipment Corp., Dept. MF, 19 S. Byrkit St., Mishawaka, Ind.

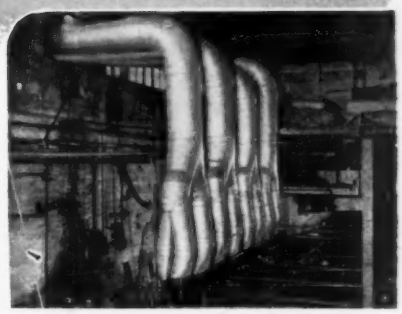
Bulletin No. 41-A on American

Ohio FUME AND DUST REMOVAL SYSTEMS
TANGIBLE DOLLAR SAVERS

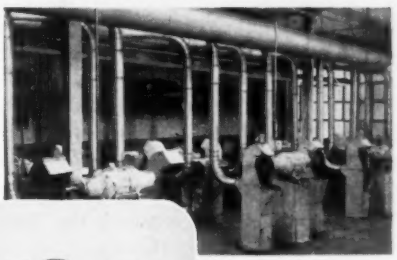
● Records on hundreds of Ohio Blow Pipe jobs prove without question that production output materially increased and employee absence and complaints radically decreased after the installation of an Ohio System for ventilation of fumes from plating and rinse tanks and dust collection from grinding, polishing and buffing.

Ohio Systems are not standard fit-all systems. They are designed and engineered to meet your individual requirements. Ohio engineers, thoroughly experienced in their field, make a careful, exacting survey of your plant and an analysis of conditions and then plan the system that will meet most efficiently your special needs and conditions.

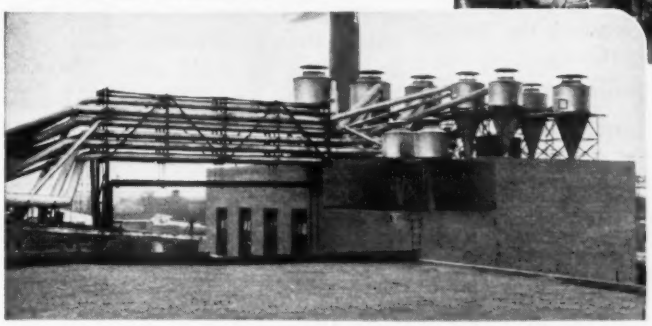
Call, write or phone today and let Ohio engineers make a survey and give you, without obligation, an estimate.



Fumes Removal Installation in Plating Room



Dust Collecting System for Buffing Machines



Cyclone Type Dust Collectors

Ohio BLOW PIPE CO.
ENGINEERS AND MANUFACTURERS
1725 DOAN AVENUE • CLEVELAND 12, OHIO

pressure tanks for airblasting is now available from this firm. The four-page bulletin describes tanks that operate continuously and intermittently. Pictures and detail drawings illustrate the text. The tanks are convenient, semi-portable and ideal for high and low pressure blast cleaning, for cutting monument inscriptions, and for similar work, it is claimed.

Water Demineralizers

Barnstead Still & Sterilizer Co., Inc., Dept. MF, 129 Lanesville Terrace, Forest Hills, Boston 31, Mass.

This firm has issued a new comprehensive catalog which describes in detail the difference between distilled and demineralized water. This 20-page catalog highlights the advantages of either distilled water or demineralized water as used in manufacturing and processing operations which call for pure water. It answers the question "What is the difference between distilled and demineralized water?"

It also cites case histories on quality control of water that has resulted in better products, uniform results, fewer rejects, and the reduction of costs in plant operations. It shows how ion-exchange purification works with the catalog containing more than 30 illustrations.

The manufacturer offers to send Catalog 123 to anyone interested in pure water and states that the Barnstead Engineering Dept., will be glad to make recommendations on equipment for special applications.

Copper Blasting Abrasive

American Wheelabrator and Equipment Corp., Dept. MF, 555 S. Byrkit St., Mishawaka, Ind.

"Copper Shot for Blast Cleaning and Finishing Non-Ferrous Metal Parts" is the name of a new bulletin now available from this firm.

Described are the advantages of copper shot, a material only recently introduced to industry, in cleaning and finishing brass and other non-ferrous castings. To cite a few claims: (1) superb finishes of natural color, (2) no imbedding of hard abrasive in soft non-ferrous parts, (3) no subsequent rusting or staining, (4) no contamination of non-ferrous melts from iron abrasive getting into the remelt material, and (5) greatly increased life of the wearable parts of the blast cleaning machine. In addition, copper shot is said to last longer than iron abrasive because it wears down, does not break down. Performance results are enumerated, showing the advantages in appearance, cost, etc.

Industrial Control Instruments

Minneapolis - Honeywell Regulator Co., Industrial Division. Dept. MF, Wayne and Windrim Aves., Philadelphia 44, Pa.

Industrial control devices for temperature, flow, pressure, liquid level and humidity, Catalog 8303, has just been published by the above firm. This 64-page catalog presents over 100 different models of non-indicating electric, electronic, and pneumatic controllers that have innumerable uses in industrial applications.

A number of important additions to the previous line are shown for the first time, including electronic temperature controllers, self-contained electric temperature controllers, and pneumatic insertion type temperature controllers; magnetic starters and contactors; heavy-duty pneumatic positioning motors; pneumatic auto-

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"THE OXIDIZING AGENT OF TODAY"

For stripping copper and producing various oxidized finishes on copper and silver.

Economical. **Simple to use.**

Order on trial and approval

Sulphur Products Co. Inc.

Greensburg 7, Pa.

matic reset relays and electric step controllers.

Exhaust Fan Engineering Data

Chelsea Fan & Blower Co., Inc., Dept. MF, 1206 Grove St., Irvington, N. J.

A new illustrated catalog giving full engineering information, dimensions, performance and prices regarding all types and sizes of fans for industrial, commercial and residential applications. This catalog includes many new types of fans with full details as to their application. Included is information on direct drive or belt-driven window fans, industrial pressure fans, mancoolers, PH units, duct booster fans and various fans of all kinds and description. Also a full line of automatic counter balanced shutters for all applications. One of the most complete and easy to understand catalogs available on this subject.

News from California

Electri-Form Plating Co. has been established at 7134 North Laurel Canyon Road, North Hollywood, by *Sherwood Denies*. The new shop is equipped with some $10,000 worth of machinery supplied by "*Carload Andy*" *Ospring* of the *Sundmark Supply Co.* Among new equipment are two tanks for plating hard nickel, and one acid copper for plating dies for plastic items.

Premier Plating Co., 2512 West Main Street, Alhambra, has increased its facilities by the installation of a new 400 gallon bright nickel tank for general job work and a new cadmium barrel unit for general production work. *F. A. Bunt* is president of this firm, and *Harold Wannamaker* is shop superintendent.

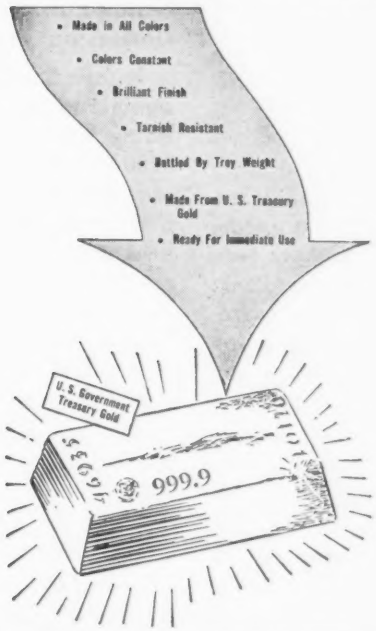
Quality Plating Co., Burbank, Calif., has installed a new chrome tank and rectifiers to supplement a new nickel tank installed some time ago. The two 16' tank units are used for plating plumbing fixtures.

Carroll McClaron, operator of the *Santa Ana Plating Works* (which is, incidentally, the only plating shop in Santa Ana, the 50,000 population county seat of Orange County, Calif.)

DAVIS-K

GOLD & RHODIUM SOLUTIONS

GOLD and RHODIUM PLATING SOLUTIONS HEADQUARTERS


• Made in All Colors
• Colors Constant
• Brilliant Finish
• Tarnish Resistant
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• Made From U. S. Treasury Gold
• Ready For Immediate Use
U. S. Government Treasury Gold
999.9

DAVIS-K—makers of GOLD PLATING SOLUTIONS—prepared in all colors that produce hard, tarnish-resistant, color constant deposits.

Compounded from U. S. Treasury GOLD and highest (C.P.) chemicals. Sold by troy weight—certified 100% gold content.

Solutions are simple to operate and maintain.

DAVIS-K GOLD SALTS—We are now making the finest in potassium and sodium gold cyanide salts. These salts come in standard percentages, unconditionally guaranteed as to fine gold content.

We welcome inquiries pertaining to precious metal plating problems. Distributors of Bakers' lustrous RHODIUM SOLUTIONS, that produce a long-lasting white finish.

"Where glittering elegance reflects lasting quality"

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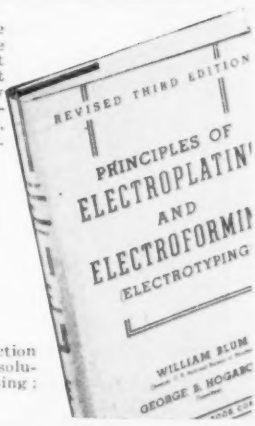
PLATING METHODS AND PROCESSES

Here are the scientific principles, practical methods, up-to-date formulas, processes and suggestions that will be invaluable to everyone concerned with electroplating and electrotyping. The most efficient modern methods of putting electrodeposits on more than 40 different metals, alloys and plastics are summarized completely in this thoroughly revised and enlarged book. You also get simple explanations of principles of electrochemistry and physics that underlie plating processes, and of recent developments in electrodeposition procedures and products.



PRINCIPLES OF ELECTROPLATING AND ELECTROFORMING

By WILLIAM BLUM
Chemist, U. S. Bureau of Standards
and GEORGE HOGABOOM
Consultant

This text gives a thorough treatment of such basic topics as protection against tarnish, corrosion, wear; qualitative, quantitative analyses of solutions; pickling, dipping; electropolishing; electroforming; electrotyping; reproducing phonograph record matrices, manufacturing tubes, etc.

Order from:

FINISHING PUBLICATIONS, INC., 11 W. 42nd St., New York 18, N. Y.

Revised 1949 Edition
455 pp., 6 x 9
illus., $6.00

reports a plant enlargement which included the installation of a bright nickel setup for job work. The shop is now equipped with ten solutions for general job work, including chrome, nickel, cadmium, brass and copper.

Electrofilm Corp., 7116 Laurel Canyon Road, North Hollywood, Calif., will install a pilot plant for the new Manodizing process of anodizing, for use in experimental work for the government and to set standards for the new process.

New west coast offices and warehouse facilities of the *Carborundum Co.* of Niagara Falls, N. Y., have been established at 5221 Pacific Blvd., Huntington Park, Calif. *William Homeyer*, who has served as sales representative for the firm in the Los Angeles area since 1925, has been named branch manager.

Cannon Electric Development Co., Los Angeles, announces the appointment of *Roger Bowen* as head of its engineering department. *D. F. Jackson* has been named assistant. Bowen was formerly with the Signal Corps as head of electronic component research.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

37th Annual Convention in Boston on June 12-15

Technical sessions of great economic significance on means of reducing finishing cost will be a feature at the 37th Annual Convention of the *American Electroplaters' Society*—also the Fourth International Conference on Electrodeposition in collaboration with the *Electrodepositors' Technical Society* of Great Britain—at the Hotel Statler, Boston, Mass., June 12 to 15, 1950.

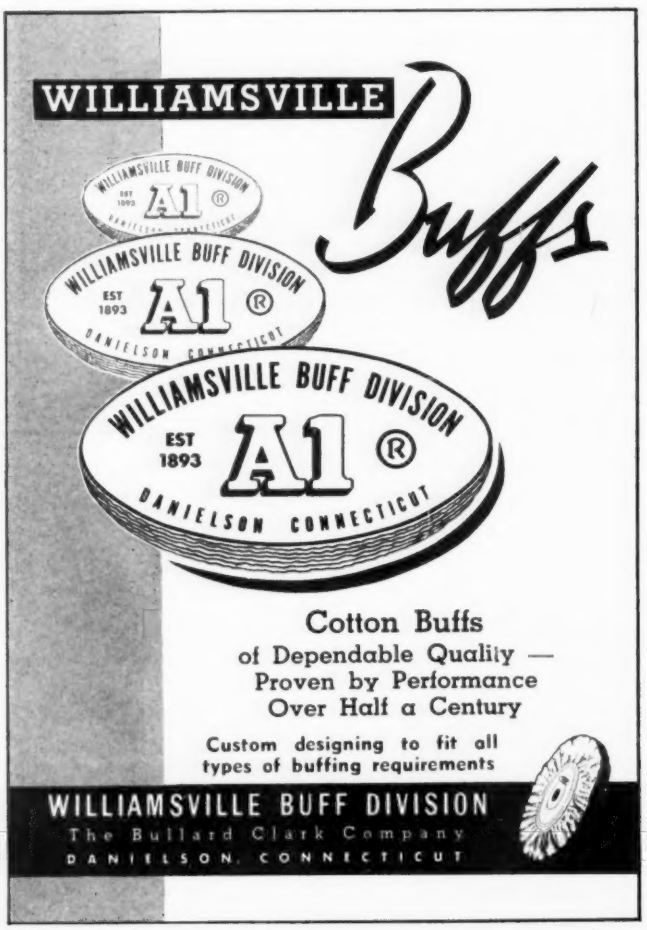
Two sessions on Smoothing and Levelling Processes in Electroplating will be held all day Wednesday, June 13, at which outstanding leaders in this relatively new field will report and discuss their most recent findings.

The papers to be presented include the following subjects:

"Measurement of Surface Smoothness."
"Levelling and Smoothing by Chemical and Electrochemical Polishing."
"Levelling with PR Current."
"Some Observations of Microthrowing Power of Plating Solutions."
"Levelling of Cobalt-Nickel Plating Solutions."
"Surface Contour and Levelling."

The importance of these sessions cannot be overestimated, coming as they do at a time when increased competition and rising costs are forcing manufacturers to explore all possible means of producing quality finishes with less polishing and buffing expense.

Supplementing the sessions, which will extend over the four-day program, there will be the usual round of social activities, plant visitations, Fellowship Club program, and a special program for the entertainment of the ladies attending. A number of sightseeing trips through historic Boston and its suburbs has been arranged, and a mammoth New England clambake will also be held. The annual



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meeting of the Society, when the new officers will be elected for the coming year, will be held on Thursday afternoon, June 15.

In addition to the many pleasing entertainment features, including a luncheon for Electrodepositors' Technical Society Members in the U. S. and abroad, the Founder Members (1909-1913) of the American Electroplaters' Society, of whom unfortunately there are too few living today, will be honored.

Chicago Branch

At the March 10th meeting 40 members and guests were present for dinner, with a total attendance of 115 at the regular meeting. *Mr. Sam Johnson*, Past President of the Supreme Society, and present Technical Director of Plating at Weirton Steel Co., was the principal speaker. His topic was "Electrolytic Tin Plate". Mr. Johnson's talk was illustrated with sound color movies, which assisted materially in conveying the enormity of the operation involved in this industry.

Prior to Mr. Johnson's talk the Nominating Committee presented the following slate of officers for 1950-51: President, *Dr. J. H. Monaweck;* First Vice-President, *A. G. Bartmann;* Second Vice-President, *Clem Petrosius;* Librarian, *J. M. Andrus;* Secretary-Treasurer, *Paul Glab;* Board of Managers: Chairman, *Marion Longfield, J. Boudreau, R. F. Ledford;* Delegates, *C. Kelly, J. Andrus, P. Glab;* Alternates: *G. Gilbertson, M. Longfield, R. Hazucha.*

All the above were unanimously elected to office for the coming year. The next meeting, to be held April 14, is to be a social meeting to which the ladies will be invited. At that meeting the newly elected officers will be installed and those in attendance will also witness a sound color movie on "America's First Silver Plate."

Los Angeles Branch Annual Educational Meeting

Arthur W. Logozzo, of Hartford, Conn., president of the A.E.S., was the guest of honor and principal speaker at the 20th annual educational session of Los Angeles Branch, American Electro Platers Society, which was held March 18 at Rodger Young Auditorium, Los Angeles.

One hundred and ten members and guests were present when Branch President *Allan Sulzinger* called the technical session to order at 10 a.m. The program consisted of two separate technical meetings of two hours duration each, with two speakers addressing each session. The period from 10 a.m. to noon was devoted to discussions on the economic and administrational phases of plating shop operation; the afternoon session to practical problems concerned with various types of metal deposition.

Session Chairman *G. D. McDonald, Jr.*, introduced as the first speaker *Walter P. Behlendorf*, of Spence Electro Plating Co., Los Angeles. Mr. Behlendorf's talk on "The Economics of Plating" was one of the highlights of the conference. His paper reflected the intense amount of research he had engaged in to bring to the branch members facts, cost figures, operational procedures and practices as found in the average Southern California plating shop. Locally, he said, some 167 concerns are performing plating of various kinds, employing 2,000 workmen in plating shops in which $10,000,000 worth of plated products

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are produced annually. This does not include plating done by manufacturers operating their own plating shops. Mr. Behlendorf estimated the number of shops on the entire Pacific Coast at 350.

His paper was replete with figures that showed the cost of materials in an average California shop. He supplemented this with data on basic costs that enter into a plating operation. These figures, according to the speaker, were taken directly from the profit-and-loss statement of a local plating concern.

The paper presented many interesting figures on the breakdown of various plating costs, such as labor (38%, plus 5¼% for hidden labor costs represented by such items as paid vacations, Social Security payments, etc.). Mr. Behlendorf's conclusion was that the average profit per plating job is about 3%. He concluded his excellent talk with some comment on job estimating, minimum charges and a review of the general economic picture.

The second speaker at the morning session was *John V. Davis*, chief engineer, Udylite Corp., Detroit, Mich. Mr. Davis spoke on "Full Automatic Equipment." Since the subject is too comprehensive for full treatment in one talk, Mr. Davis chose to concentrate on the phase of savings by the use of a full automatic machine.

He reviewed the three general types of machines and discussed their features and limitations. Defining the comparative features of the straight-line, return-type and rotary machine, he gave facts on each dealing with floor space, rack size, rack weight when loaded, installation cost and time, maintenance cost, head room, machine and anode accessibility, load and unload points, and ventilation. The speaker also added some comment on production and process control, solution maintenance, and uniformity of operations.

Mr. Logozzo made the first of two talks at the noon luncheon. This was attended by some 100 members and guests. The national president was introduced by an old New England associate, *Stuart Krentel*, now Pacific Coast manager for MacDermid, Inc., who served as toastmaster. Mr. Logozzo had earlier in the day conferred with *Donald Bedwell*, chairman of the Los Angeles convention committee, *Richard Wooley* and other members of the committee which is making arrangements for the 1951 A.E.S. convention. Mr. Logozzo expressed himself as gratifyingly surprised at the progress which had been made and said it appeared to him that the 1951 convention could not help but be a success with the careful planning that is being devoted to it.

The second technical session took place from 2 to 4 p.m. The first speaker at this session was Mr. Logozzo who delivered a talk on "Bright Nickel and Decorative Chrome Plating," which was illustrated with sides.

The next speaker was *Dr. M. M. Beckwith*, Manager of Technical Sales, *Harshaw Chemical Co.*, Cleveland, O. His subject was "Leveling Properties of Electrodeposited Nickel."

A products exposition was held in connection with the educational session. In some 30 booths lining the auditorium, local and national equipment and chemical manufacturers and distributors displayed their wares.

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The branch's annual diner dance was held in the evening, beginning at 7:30 p.m. A special event this year was a waltz contest for which the *Kaag Manufacturing Co.* donated two beautiful trophies to the winning couple. *Mr. and Mrs. Paul O. Franke.*

April Meeting

A talk on rectifiers by *Keith Holtzclaw* of the *Industrial Electronics & Transformer Co.*, was the highlight of the educational session of Los Angeles Branch, American Electroplaters Society on April 12th.

The speaker presented an informal discussion of the place of rectifiers in the plating shop. He emphasized that proper installation is the key to successful rectifier operation. A rectifier, he declared, should be installed where clean, fresh air is available, and not adjacent to or on top of a plating tank, where it is found in many job shops. Mr. Holtzclaw also referred to the versatility of rectifiers, explaining that operations may be started with a small unit and the capacity gradually increased as needed. In comparing rectifiers versus motor generators, he cited factors in favor of rectifiers as being high overload capacity, no warming-up required, less floor space required, and lower stand-by loss.

The new branch officers, who had been elected at the March meeting, were installed. *Earl Coffin* served as master-of-ceremonies at the installation services. *Richard Wooley*, Pacific Coast district manager of the *Udylite Corp.*, was installed as 1950-51 president, succeeding *Allan Sulzinger*. The retiring president was presented with a wallet as a token of the chapters esteem. *Lawrence O'Neill* was appointed by Wooley to serve as sergeant-at-arms.

John Hammer was initiated into membership. *John F. Beall* reported that two additional $100 sustaining memberships for the research fund had been obtained, these being the *George E. Nichols Co.* and *Price-Pfister Co.*

President Wooley reported that the branch is endeavoring to assemble material for an impressive exhibit at the Boston AES convention in order to give the delegates some idea of the tremendous scope of plating on the West Coast. He urged members to submit work samples in time for shipping to the convention.

The following guests were introduced: *William Stevens*, Progressive Plating Co.; *Frank O'Dell*, Surface Plating Co.; *B. W. Scoggins*, *F. E. Sumerall*, Spartan Engineering Co.; *C. L. York*, General Electric Co.; *James Ashley*, Turco Products Co.; and *C. M. Brown*, Bone Engineering Co.

L. W. Reinkin Heads Metallic Rectifier Committee of N.E.M.A.

The Metallic Rectifier Section of N.E.M.A. (National Electrical Manufacturers Association) has committees of particular interest to electroplaters. A committee on Electroplating Rectifier Units, which has been working for the past eighteen months, hopes soon to complete standards for performance, testing, applications, etc. Standards will be published and will be available to all who are interested, including users of rectifier units. This year, committee is headed up by *L. W. Reinken*, of W. Green Electric Company, Inc. *S. W. Berman*, also of W. Green Electric Company, Inc. is chairman of Committee on Definitions. The Section chairman is *T. Finnell*, of Westinghouse.

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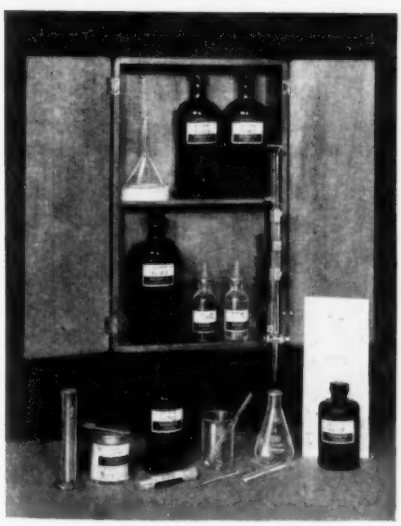

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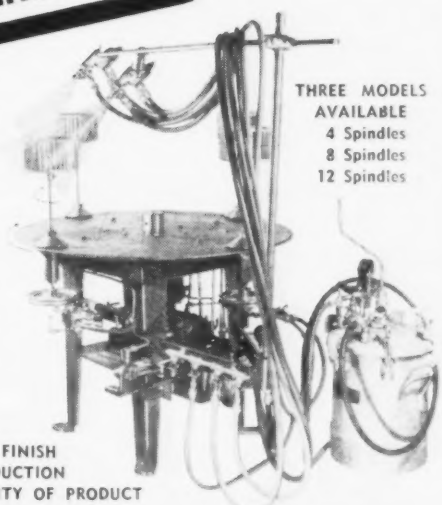

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Galvanizers Meeting in Toronto

The spring meeting of The Galvanizers Committee, sponsored by *American Zinc Institute*, will be held at the King Edward Hotel, Toronto, Canada, on Thursday and Friday, May 18 and 19.

According to *Robert Stoker*, Carnegie-Illinois Steel Corp., Chairman of the Governing Board, the program at the morning and afternoon sessions on the first day will consist of round table discussions of equipment and materials used in the galvanizing shop, and topics related to operating problems. These sessions will be for Committee members only.

The highlight of the dinner session on Thursday evening will be the presentation of the Committee's first Annual Award to *Mr. Tadeusz Sendzimir*, Vice President of Armzen Co., for fundamental achievements in the art of galvanizing sheets.

Friday, the second day of the meeting, will be devoted to an inspection tour of the operations of the Lysaght Dominion Sheet Metal Corp., Ltd. and the Steel Company of Canada, Ltd. in Hamilton, Ontario.

NEW BOOKS

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Published by Franklin Roberts, 3288 W. Boston Blvd., Detroit 6, Mich. Price $3.00. 80 pages 8½ x 11.

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A new book has just been published which deals very thoroughly with this vital subject. It contains the Federal Water Pollution Act No. 845; several state laws and a typical city ordinance. From these statutes management can learn what is required by law and the penalties for failure to comply with the law. In some instances the penalties are very severe.

The volume also contains numerous technical articles with charts, tables and formulae—all written by leading chemical engineers, consultants and others whose experience qualifies them to write on this subject. The articles deal with various phases of this vital problem; tells (with illustrations and diagrams) how some plants have already solved their problem, and, in some cases, have turned waste material into profitable by-products.

Journal of the Electrodepositor's Technical Society (England)

Published by the Electrodepositor's Technical Society, 27 Islington High St., London N. 1, England. Price to non-members $6.00 plus postage.

This volume contains the papers and discussions presented at the various meetings of the E.T.S. during the 1948-49 sessions, as well as the various reports of the society officers and an account of the annual meeting.

The list of papers follows:

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ating Polished Surfaces. *By E. A. Ollard.*

The Sodium Hydride Process—A New Method of Descaling Metals. *By N. L. Evans.*

The Surface Appearance of Polished Metals — Physical and Psychological Considerations. *By G. E. Gardam and J. F. Mills.*

The Estimation of Cobalt in Bright Nickel Plating Solutions. *By H. D. Carter.*

The Chemical Colouring of Metals —Some Reactions Involving the Slow Liberation of Sulphur, Selenium and Tellurium. *By M. C. N. Holt and A. M. Ward.*

The Welding, Brazing and Soldering of Coated Metals. *By E. V. Beatson.*

Practical Aspects of Plating in the Spoon and Fork Trade. *By F. R. Hill.*

Recent Developments in Low-Tension Power Supply. *By D. Ashby.*

Electrodeposition in the Printing Industry. *By P. B. Upton.*

Latest Developments in Phosphate Coating Methods and Technique. *By H. A. Holden.*

Anodic Oxide Coating Formation

Tank Linings and Insulating Materials. *By V. Evans.*

on Aluminum Alloys. *By W. N. Bradshaw and S. G. Clarke.*

Some Aspects of De-Burring and Polishing in Barrels. *By H. Weiss.*

Barrel Plating to Specification. *By A. W. Wallbank.*

Causes of Blistering of Electrodeposits on Zinc Alloy Die-Castings. *By S. Wernick, H. H. Symonds and H. C. Castell.*

The Annual Meeting.

CORRECTION

Electrolytic Polishing

By Dr. P. A. Jacquet

Dr. Jacquet has called our attention to several errors in the series of articles recently completed in *Metal Finishing*, and in order to make this presentation complete, these errors are listed here:

Sept. 1949, p. 62, Figure 23—The picture is reversed; lead deposit is on bottom, base metal at top.

Oct. 1949, p. 70, Figures 38-39-40—The concentration of NaOH should be 0.1N instead of 0.4N.

Jan. 1950, p. 58, Figure 44—Solid line represents mechanically polished specimens, dashed line represents electropolished specimens.

p. 60, Figure 45a—Directional arrow missing. Should point towards top of page.

p. 60, Figure 45b—Two directional arrows missing. Should point towards top and side of page.

Feb. 1950, p. 55, Figure 47—Picture reversed. Darkest square should represent "after electropolishing".

p. 57, Figure 50—Top $\frac{1}{4}$ of both speciments mechanically polished only.

In addition to these corrections in the photo captions, the statement on page 65 of the Sept. 1949 issue, left column, last sentence, should have read "However, the very smooth microgeometry of the electropolished surface is a favorable condition for this detection."

Dr. Jacquet also points out that reductions or enlargements in printing of the many photos used will modify the magnification figures given.

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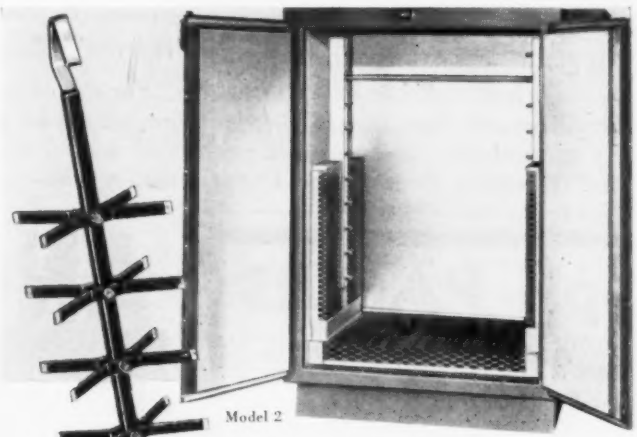

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Letters to the Editor

The "Heart" of The Plating Industry

Mr. W. A. Raymond, Editor
Metal Finishing,
New York 18, N. Y.

Dear Walter:

I have noted with interest your Editorial of March in which you refer to Detroit as being the "heart" of the plating industry in the United States.

It is a good plan to have news from large centers of electroplating, but to state that one section (Detroit) is the "heart of the industry" is not quite correct, unless of course you consider that the heart consists of copper-nickel-chrome.

New England has far more diversified lines of electroplating than any other section, not only of this country, but of the world. Where can you find in such a limited geographical area a place where not only copper, nickel, and chrome plating is done, (and done as well as in any other place), but also gold, silver, rhodium, palladium, cadmium, tin, zinc, lead, indium, arsenic, nickel-cobalt, brass, bronze, etc. etc. on a full commercial scale?

Without question there is more precious metal plating done in the Providence-Attleboro district than in any other section. From a recent personal survey in three of the largest silver plating plants there is over 100,000 gallons of silver plating solution. Compare the cost of these with that of baser metals.

When extra large, massive parts are to be chrome plated they are sent to New England, because the leading authorities on hard chrome are in New England.

The successful production on a commercial scale of the electroplating on plastics in bulk was developed in New England.

The first full-automatic plating equipment, without which Detroit would be lost, was developed, patented, and successfully operated first in New England.

When the "heart" of the electroplating industry is sought, come to New England and you will find it; and that "heart" is so generous that it has been the instructor for generations for the rest of the country's platers.

Yours truly,
GEORGE B. HOGABOOM.

P.S. Don't overlook that nickel plating, without which Detroit would not be able to produce their shiny new cars, was developed by a New Englander, Dr. Isaac Adams.

(EDITOR'S CONFESSION—

For a dyed-in-the-wool, lifetime Nutmegger to be accused of treason by such a loyal son and defender is more than a man can stand. I plead guilty as charged, and throw myself at the mercy of the above-mentioned generous hearts of New England's competent, and hereby admitted superior plating fraternity. Give me the chair or the gas chamber, but please don't banish me from my native hills and valleys to the noisy, frantic pace of the Motor City. W. A. R.)

Plating Over Soft Solder

Mr. Walter A. Raymond, Editor
Metal Finishing
11 West 42nd St.
New York 18, N. Y.
Dear Mr. Raymond:

In the February issue of Metal Finishing, under the "Shop Problem" section, page 67, a question was asked concerning the plating over soft solder.

We do a great deal of this particular type of work and have been rather fortunate in obtaining quality plating over the soft solder.

It is brought out in the answer to the query that one should end up the washing operation with a hot alkali dip. Most soldering is done with a flux with a zinc chloride base. If any of the flux remains, after the washing operation, it will be saponified by the hot alkali. The formed zinc soap is all but impossible to remove.

We have found that the best way to insure the removal of all the flux, prior to plating, and eliminate the saponification headache is to thoroughly

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clean the soldered section with either methyl, ethyl, or iso-proyl alcohol. Most of the standard fluxes are readily soluble in these solutions.

I do hope that the above explanation will be of some help. If additional data is desired, I will be glad to furnish it.

Yours truly,
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OBITUARIES

HERBERT M. KAUFMANN

Dr. Herbert M. Kaufmann, Chairman of the Board of Directors of *Mutual Chemical Company of America,* died March 20th, at his home after a short illness. He was in his eightieth year.

Born in Philadelphia in 1870, he graduated as a chemist at the age of eighteen from the University of Penn., continued his studies abroad at the Swiss Polytech, Zurich, and obtained his doctorate in chemistry in 1891 from the University of Basle. He moved New York in 1909.

In 1896, he joined the Mutual Chemical Company of Jersey City as chemist, superintendent and works manager. In 1908 that company and the American Chrome Company were merged to form the present Mutual Chemical Company of America. Dr. Kaufmann was its President from 1933 to 1943 and the Chairman of its Board of Directors since then.

For many years he was a Trustee of the Free Synagogue and Treasurer of the Jewish Institute of Religion. He was a member of the Harmonie and Chemists' Club.

Dr. Kaufmann is survived by his widow, and by two daughters.

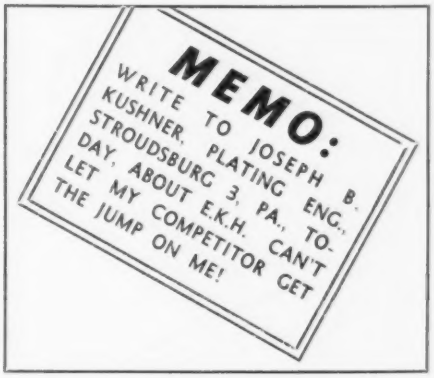
WORTH W. MATHEWS

It is with deepest regret that we report the passing of *Mr. Worth W. Mathews,* the Michigan and Northern Indiana sales representative of Lasalco, Inc., of St. Louis, Mo. Mr. Mathews had travelled this territory for 22 years, during which time his sincerity and congeniality had won for him a host of friends. He was a resident of Kalamazoo, and at the time of his death was 62 years old.

JAMES STEWART

We anounce with regret the passing of one of the old timers of the plating industry, *Mr. James Stewart.*

Mr. Stewart began his carreer in the plating field with the Kalamazoo Plating Co., and for a while was associated with the Bronson Mfg. Co. in Bronson, Mich. At the time of his death Jim Stewart was running three job plating shops, located in Hillsdale, Battle Creek, and Jackson, Mich. Jim had built up a great many friends in his years in the plating industry, and his genial presence will be missed by those who knew him.



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100	7½	1800	Hobart	110/220-1/60
350/175	7½-15	1200	Roth	220-3/60
500/250	6/12	1200	American Giant	
1000	6	1200	H. V. W.	220-3/60
1500/750	6/12	900	Electric Prod.	440-3/60
2000/1000	6/12	600	H. V. W.	220-3/60
2000/1000	6/12	600	Chandeysson	220-3/60
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